

PETA'S PIG FIGHT \* LULU: THERE GOES THE NEIGHBORHOOD \* UDDER ANGST & BGH

# GARBAGE

THE INDEPENDENT ENVIRONMENTAL QUARTERLY  
SUMMER 1994

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# Never Say Never

**T**HE LETTERS TO THE EDITOR USED to wail, "Drop the advertising, you sell-outs!" We did drop the ads, and now the worried letters come: "Why'd you drop the ads? — you'll put yourself out of business!" There's no irony, however; I'm just getting corroboration of the old publishing truism Happy Readers Don't Write.

Readers who argue that dropping the ads to satisfy the fringe was unnecessary are right. That's not why the ads are gone. I'd gotten flak for accepting advertising since day one (remarkably, considering that the overwhelming majority of magazines sell space). Bowing to such pressure would be a naive business move, not to mention a form of censorship.

I need not explain our situation, but it's sort of interesting, whether or not you're in publishing. Also, I reserve the right to sell space again in the future. With that in mind, let me explain why this was a business decision, not a moral one.

**Advertising is not a moral issue.** In five years, no advertiser ever tried to interfere with or influence editorial. If one had, he would have been told politely that that wasn't how we do business, which is still an acceptable thing for a publisher to say.

**In GARBAGE, advertising was not a revenue source.** This may shock many readers and publishing folks, but the advertising pages in GARBAGE regularly lost money. Not only did they not cover editorial costs, but they did not even pay for themselves. That is, as a "stand-alone busi-

ness" — with ad revenue on the credit side, and salespeople salaries, promotion budget, and proportion of the paper bill on the debit side — advertising sales operated at a loss. True, we replaced the ad pages with editorial, which is relatively expensive at GARBAGE. But we made the frequency quarterly, thereby cutting one-third of mailing costs. In short, the change did not remove an important revenue source; rather, it was financially sound.

**The "pressure" was to maintain rate base.** In magazine publishing, we have a legal contract and ethical responsibility to advertisers to deliver the number and quality of readers they have paid to reach. The ad sales staff was fighting a two-fold dilemma: Circulation numbers were declining as we avoided large direct-mail drops in favor of specialized promotion; and the readership was changing from the promised "general-interest consumer" to a quasi-trade/academic audience.

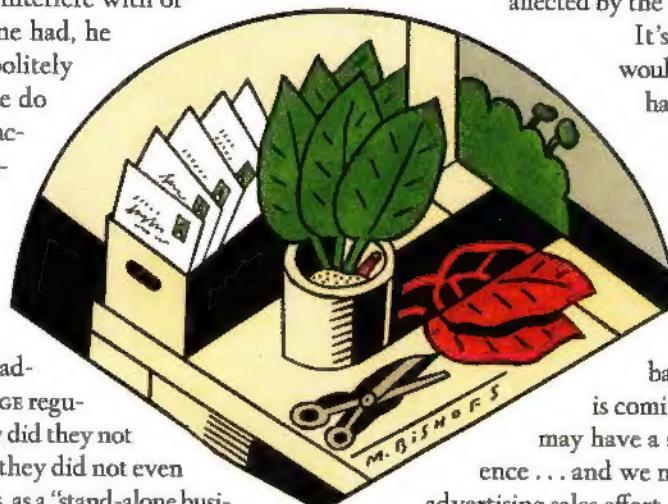
Our other publications are small, but targeted and consistent, often outperforming expectations. We had never been in a position to apologize to advertisers before. Frankly, we didn't like it.

ONE READER DID UNDERSTAND THE BUSINESS DECISION TO BE circulation-driven, but questioned the impact of making the magazine more expensive. Will a higher price mean GARBAGE will reach only the converted? The lower the

cost, the greater the number of people potentially affected by the editorial.

It's a legitimate thought. I would say, however, that GARBAGE has never been an impulse buy.

Right now, exploring environmental topics in depth is not a mainstream concern. I have some sense that GARBAGE and our writers are a step ahead, that open-minded debate on environmental issues is coming. By that time, GARBAGE may have a steady and definable audience . . . and we may confidently renew our advertising sales effort.



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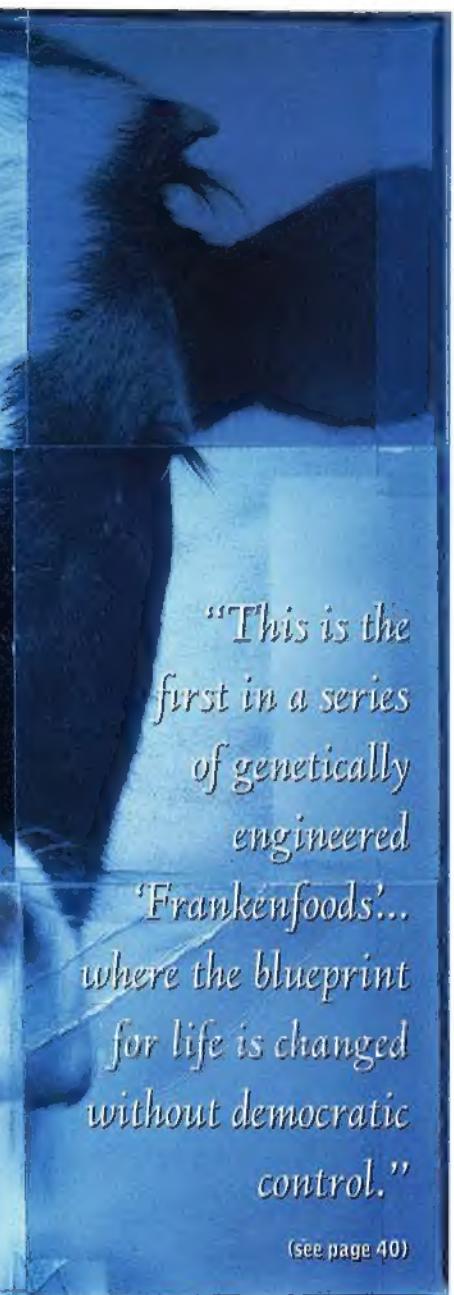
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COLUMNS



"This is the first in a series of genetically engineered 'Frankenfoods'... where the blueprint for life is changed without democratic control."

(see page 40)

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\* \* \* \* \*

**ON THE COVERS:** Cover illustration by Amy Guip, New York City. Back cover illustration by Ward Schumaker, San Francisco.



## LETTERS TO THE EDITOR

### Radon: The 'Silent Killer'?

SPRING 1994

I AM A REGISTERED PROFESSIONAL ENGINEER (Penn.) [and] first president of the Berks County Committee for Clean Air in 1962. I worked as a contamination control engineer for one of America's leading companies, until I retired.

In 1960, I purchased a house in Reading. It would prove to be in the center of one of the worst radon areas. At that time I smoked heavily. I lived there until 1987. My wife still lives there and did, continuously, except for a period of five years. My two children were born and raised there. One grandchild was born there. None of us has any lung problems.

When the radon scare started, I tested the air in our basement recreation room. The radon level was so high that the EPA sent someone to the house. Unfortunately, I was at work when he visited. He proceeded to frighten my daughter by telling her that the radon level in our basement was so high as to make the breathing of the air equivalent to smoking 20 packs of cigarettes per day (400 cigarettes).

The point missed by everyone was brought out in [your] article. Radon gas is breathed in and out! The half-life is only days. All of the [EPA] data was extrapolated from radium mine levels. All mines are dusty. Radium has a half-life of thousands of years and is known to cause cancer. Dust breathed in, stays in. You cannot go into a radium mine, take radon measurements, and extrapolate them to miners' lung cancer while com-

pletely ignoring the radium dust — and then use your erroneous figures to scare the populace. I and my family are living proof that the EPA engages in overblown scare tactics.

— RICHARD A. YEICH  
Reading, Penn.

### New in this Issue

SPRING 1994

Our decision to carry no paid advertising generated more mail than any feature article in the previous issue. Patricia Poore responds to these readers on page 3.

WE HAVE NOTICED THAT YOUR ARTICLES attempt to see all sides of an issue, and are amused by the strident letters from the liberals. You've come a long way (grown up?) since your first issue, when you took up the Alar hysteria.

Your detractors will not appreciate the financial risk you've taken by removing the advertising. These folks never consider economics as relevant to their world; they are too busy writing grants so the government will support them.

— JOE SLADKY  
Livermore, Calif.

I HAVE NEVER SUSPECTED GARBAGE OF being controlled or swayed editorially by large corporate advertisers. In fact, your gradual and balanced increase in advertising content has provided me with a resource. Some of your advertisers have seemed crackpot to me, and others deceitful and conniving, but most have been interesting and informative. A few even succeeded in

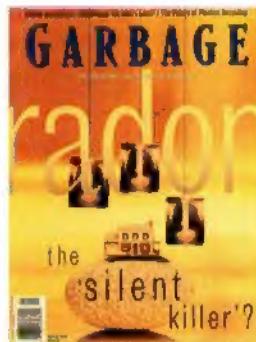
### Radon: Worse Than Feared??

SPRING 1994

RADIOLGISTS specialize in the interpretation of medical images, including x-rays. I was therefore glad to see chest radiographs displayed on the cover of your Spring 1994 issue featuring a cover story on the harmful effects of radon gas.

It was difficult, however, not to notice that on all images, the heart and liver are on the side opposite their normal anatomic locations. Either the films are hung backwards, or radon is a far greater health threat than anyone ever imagined.

— ALAN P. NAZERIAN, MD  
New Berlin, Wis.



selling me something, I always felt that it was up to me, as a thoughtful reader, to sort out the bullshit. Believe it or not, I will miss the ads.

I will happily ante up for the new, high(er) priced version of GARBAGE. Who knows, maybe someday you'll bring back the ads.

— RICHARD G. PARKER  
Amesbury, Mass.

I AM QUITE FRANKLY REPULSED BY YOUR magazine. Its arrival in my mailbox actually makes me wince. Please cancel it. I can't bear it any longer.

What has pushed me to write this letter is not the general irritation I always feel at the conservative, pro-business attitudes in your pages — but that I see [in a 1993 issue] a full-color advertisement for Waste Management, Inc., the most egregious of corporate criminals! I suggest you read the 1991 Greenpeace publication "Trash Into Cash; wmi's Environmental

Crimes and Misdeeds." Such a company is your friend? Their very wealthy executives should be jailed for their overt and unpardonable harm to humans and to our environment.

— HEATHER MACDONALD  
New York, N.Y.

## Time to Dump Plastics Recycling?

SPRING 1994

ART KLEINER AND JANIS DUTTON HAVE not considered two important options for making plastics recycling more economical. As a short-term response, a federal virgin materials tax could be enacted to create a more level playing field. And, for the long term, in a manner supported by previous GARBAGE articles, full-cost accounting should be incorporated and replace a virgin materials tax.

By using full-cost accounting, considering the complete environmental and social costs of plastics production and waste management, the free market can determine [whether] virgin or recycled makes more economic sense. Society subsidizes virgin plastics because of the lack of information in the "free market." Until the true and complete costs of virgin plastics are included in consumer prices, the market cannot accurately respond. Maybe then recycling will make sense (or maybe it won't).

— TIMOTHY S. MULHOLLAND  
Madison, Wisc.

DESPITE THE IMPRESSION LEFT BY YOUR article, plastics recycling is growing. More plastics reclamation facilities exist than a year ago, more pounds of plastics were recycled in 1993 than ever before, and more and

more products are being made from recycled plastic material.

Some of this success can be attributed to the plastics industry's interest in sustainable plastics recycling. The U.S. plastics industry and American Plastics Council (APC) members continue to work with recyclers and communities as they attempt to reduce costs, promote improvements in the recycling infrastructure, transfer technology to collections and recycling, and increase the number of products made from recycled plastics.

Ultimately, the recycling of any material will succeed only if free-market economics create competitive recycled products. While some critics seek to create artificial demand by

In 1993, the largest American chemical companies, DuPont, and the largest U.S. based leading companies, Waste Management Inc., announced a far-sighted joint venture called the Plastics Recycling Alliance. They will build new facilities in Chicago and Philadelphia using state-of-the-art automated equipment to sort, grade and melt down the two most popular types of plastic bottles and containers — polyethylene terephthalate (PET) and polyethylene terephthalate (PETE) plastic bottles. The newly built PETE plastic melt-down facility is given sole rights and high demand of polyethylene terephthalate (PET) plastic bottles from major consumers. Local plastic toy, Vicks, and other suppliers DuPont chemists will experiment with the recycling process, developing new types of recycled plastic products as transforming fibers from old plastic bottles into a new market. By 1995, the joint venture will appear five facilities, including one additional recycling plant. A new PET profile has financially worldwide. Two years and about \$22 million later, the venture collapsed.

Time to Dump Plastics Recycling?

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forcing recycled content upon producers and consumers, such moves have historically proven to backfire, and end up disrupting long-term, free-market growth. Are the recycled products in demand by consumers, and are they being aggressively procured by local, state, and federal governmental agencies?

What [such] articles fail to recognize is that in determining a product's environmental attributes, recycling is a component — not the total picture. For example, plastics' inherent quality of being lightweight and energy efficient (excellent attributes in waste reduction and conservation

of resources), while potentially presenting a challenge to some conventional collection programs that operate on a cost-per-ton basis, should not be penalized in favor of heavier, less energy-efficient products. We must begin to look beyond the recycling tree to see the full environmental forest.

— DONALD B. SHEA  
Group Vice President  
American Plastics Council  
Washington, D.C.

**Art Kleiner responds:** We agree. The mainstream plastics industry has consistently supported plastics recycling (and we documented that in our article). But, at the same time, Janis Dutton and I found that the industry has consistently worked at cross-purposes. Some large plastics manufacturers have taken actions that diminish the chances that plastics recycling will succeed. Mr. Shea says aggressive procurement policies by government would help. Maybe so, but they wouldn't be enough. Plastics producers need to think of recycled plastics as an inherent part of their business, including the aspects that are only slowly profitable. Otherwise, they will undermine their own long-term, sincere good intentions.

## No Man's Land

SPRING 1994

A CONSTITUTIONAL AND FUNDING problem blocks our path back to wilderness and pre-Columbian wilderness. The Fifth Amendment, inconveniently, requires that owners of private property taken for public use receive "just compensation." The "139,000 sq. mi. across 10 Great Plains states" is mostly in private ownership. It encompasses lands ranging from short-grass pastures to the finest farm-

land on earth. At, say, a conservatively priced \$200 per acre, land acquisition would come to about \$18 billion. Of course the infrastructure would cost at least as much more. Then, there must be huge ongoing social programs to resettle (to?) the displaced people. Can the Wildlands promoters convince a hard-pressed Congress, already struggling with a \$4 trillion national debt, to spend \$50-\$100 billion for buffalo pasture. Or should we trash the Constitution to favor "charismatic species"?

But why all the emphasis on the West and Great Plains? Both quality and quantity of biodiversity are highest in moist climates such as the eastern U.S. — the location of the worst environmental damage. So let us start the Wildlands program where rewards are maximized, along the East Coast. As a pilot program to secure and assure public acceptance, let's convert to unpeopled, roadless wilderness large contiguous tracts of Massachusetts, Connecticut, Rhode Island, New Jersey, New York, Delaware, and Maryland. That done, our environmental pioneers could march westward-ho, and revert Pennsylvania, Ohio, Indiana, and Illinois. The Mississippi River would be a convenient progress milepost to hesitate and take stock. Having burned the log cabins and other structures, outshipped all non-indigenous fauna, and species-recovered the passenger pigeons, Americans could decide if they wished to continue unrolling the wilderness carpet across the West.

We see again how too many government grants and fool-funded organizations protect idle minds from discovering the origin of electricity and hamburgers.

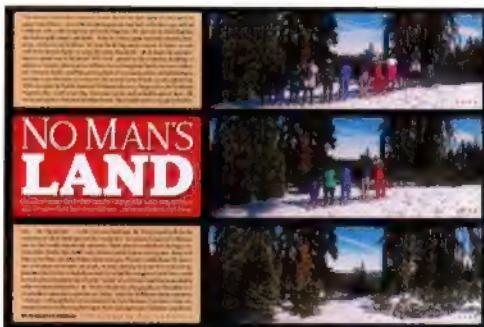
— RICHARD N. RIFE  
The Dalles, Ore.

### Dueling Quotes . . .

SPRING 1994

The Society of Environmental Journalists has a new address: 9425 Stenton Ave., Suite 209, Philadelphia, PA 19118; (215) 247-9710. The organization is holding its 1994 conference in Sundance and Provo, Utah, Oct. 6-9.

AS A 30-YEAR ENVIRONMENTAL ACTIVIST and writer, I have spent a lot of time both writing and reading other writers, as well as trying to get environmental issues addressed by newspapers, magazines, and TV, and I can assure Bill Breen that at least with regard to mass media such as NYC daily newspapers and radio such as NPR, little reliance is placed on "the PIRGS of the world." On the contrary, most



major stories read as if they came fresh off the P.R. desk of corporations.

Your publication may profess independence but I remain a skeptic, for these reasons and for what I find routine scattering of innuendoes that purport to be critical independence but which in fact skew your publication quite clearly towards an anti-environment bias.

— LORNA SALZMAN  
Brooklyn, N.Y.

IT IS, INDEED, A REPORTER'S RESPONSIBILITY to go outside the quotes, but what I [a reporter] found is that the reporters siding with the "environ-

mentalists" were tolerated even by those public and private officials being hammered, while the environmentalists, whose propaganda I [have] challenged, launched an unrelenting attack on me, one even accusing me of being on the take.

— RAYMOND HUGHES  
Claremont, N.H.

### Is Garbage an Environmental Problem?

NOVEMBER / DECEMBER 1993

I THOUGHT YOUR DEBATE WITH ALLEN Hershkowitz [Letters, Spring 1994] was sensational! Like most of those informed about garbage, he points to per-capita growth of waste generated as a sign that our society is obsessed with buying and consuming. A deeper look at the numbers actually reveals a very different picture.

It's true that per-capita waste generation has increased, since MSW growth has been greater than population growth. But per-capita consumption doesn't tell the whole story. During this same period, the number of households grew by 34.4%, a rate virtually identical to MSW growth!

When it comes to trash generation, households are really the basic unit of consumption, not individuals. That's because no matter what the size of the household, there are always fixed purchases that lead to trash generation. These include the consumption of food, grooming, and other household items; and purchases of clothing, appliances, automobiles, lawn mowers, etc.

Thus, each household has fundamental needs to be met, regardless of size. And when households divide, many of these needs must be duplicated. Consider divorce. Now there are two homes, each with basic needs.

Additional housing must be built, which results in construction discards.

Other sociologic and demographic trends have caused the rapid rise in household growth. 1) People are living longer, thus households last longer. 2) Social mores have changed, making single-parent households more acceptable. 3) The welfare system virtually forces recipients to form multiple households. 4) Elderly people are encouraged to live on their own, rather than move in with their children.

Here is another way to show that increases in MSW are based almost entirely on increases in households. Logically, trash growth should correlate with changes in expenditures for non-durable goods such as food, clothing, disposable diapers, magazines, cosmetics, etc. After all, these items and their packaging are the objects that are thrown away regularly and in large quantities. If we are truly a society of over-consumers, household expenditures for non-durable goods must increase faster than changes in household growth.

An analysis of government statistics indicates that no such increase in expenditures occurred. Between 1972 and 1987, constant-dollar household expenditures for non-durable goods remained flat, at \$12,100. This means that virtually all increases in MSW are demographic and sociographic in nature.

Does this mean that we don't have to worry about reducing waste? Not at all. But it does mean that we now have a better basis for assuring progress, since we can deal with real causes, not just ideological rhetoric.

— ROBERT M. LILIENFELD  
Executive Director  
Partners for Environmental Progress  
Ann Arbor, Mich.

**The Editors respond:** Agreed. See a similar analysis in "Demographics & Discards," p. 27 in the Jan. 1993 issue.

**T**HE SPRING ISSUE WAS REALLY GOOD! Your irreverent (at times) approach certainly rankles the "Chicken Littles" of the world. Take Mr. Hershkowitz's response. As a Senior Scientist, he should have examined the real-world data before condemning you. He keeps repeating that we throw away 4.3 lbs. of garbage every day. Actual data for suburban homes in Delaware (a reasonably wealthy state) indicates otherwise.

The average per-capita discard rate increased from 3.31 lbs. in 1983 to 3.55 lbs. in 1993 (7% in 11 years). Our voluntary recycling program has reduced the discard rate since 1991.



## Getting the Lead Out

U.S. and Canadian citizens throw away more garbage because over 80% live in single-family homes. It is unfair to compare the discard rates of various countries without looking at income and type of living quarters.

The world seems to be thriving and improving. As you know, real garbage people are, by definition, optimists! They believe that life exists because there is garbage. The NRDC must be a magnet for pessimists worried about living.

— N.C. VASUKI, P.E., DEE  
Chief Executive Officer  
Delaware Solid Waste Authority  
Dover, Del.

## Getting the Lead Out

NOVEMBER / DECEMBER 1993

**D**R. HERBERT NEEDLEMAN'S RESPONSE to Jonathan Adler's letter on the overblown lead-paint problem was a classic straw-man defense. Adler observed correctly that average blood-lead levels in the 1960s were above 20 micrograms per deciliter and that "in the 1970s average blood-lead levels were well above the CDC action level of 10 µg/dL." Adler also noted that a review panel at the University of Pittsburgh criticized Needleman's seminal lead research as containing "a pattern of errors, omissions, contradictions, and incomplete information."

Needleman responded: "He (Adler) states that average blood-lead levels in the 1970s were well above

30 µg/dL... There is not one authoritative piece of evidence to that point." He also denies that the Hearing Board found him guilty of deliberate misconduct. Needleman is right on both counts. But Adler never alleged either one.

As Adler asked: "Are we going to believe that the average child growing up 20 years ago was suffering from lead poisoning?" Needleman's non-response is that there are "a wealth of good studies... that show effects of lead on central nervous system function at levels well below 20 µg/dL." Maybe, but what does that have to do with the general population?

As Bill Breen's article implied, reporting two sides of an argument as if they were of equal weight, or as if the speakers had equal credibility, is not necessarily good journalism.

— DAN MARGULIES  
Executive Director  
Community Housing Improvement  
Program, Inc.  
New York, N.Y.

© WATER TREATMENT

# Let Them Drink Waste Water

**In the 21st century, the question we'll all be asking may well be: Is potable waste water palatable?**

By David Clarke

**P**SYCHOLOGICALLY, CAN YOU STOMACH the thought of drinking highly treated sewage?

Most water-treatment experts I talked to agree that public acceptance will be the greatest hurdle to using waste water as a drinking water source — the barriers are more psychological than technical. Even so, soul-searching time may be arriving faster than we think. Caught between rising populations with thirsts to slake and increasingly scarce, costly water supplies, some municipal officials in parched regions face a dilemma: no new water source, no commercial development. It's that simple.

Faced with soaring demand for drinking water and a scarcity of untapped sources, Tampa and San Diego are turning to treated sewage.

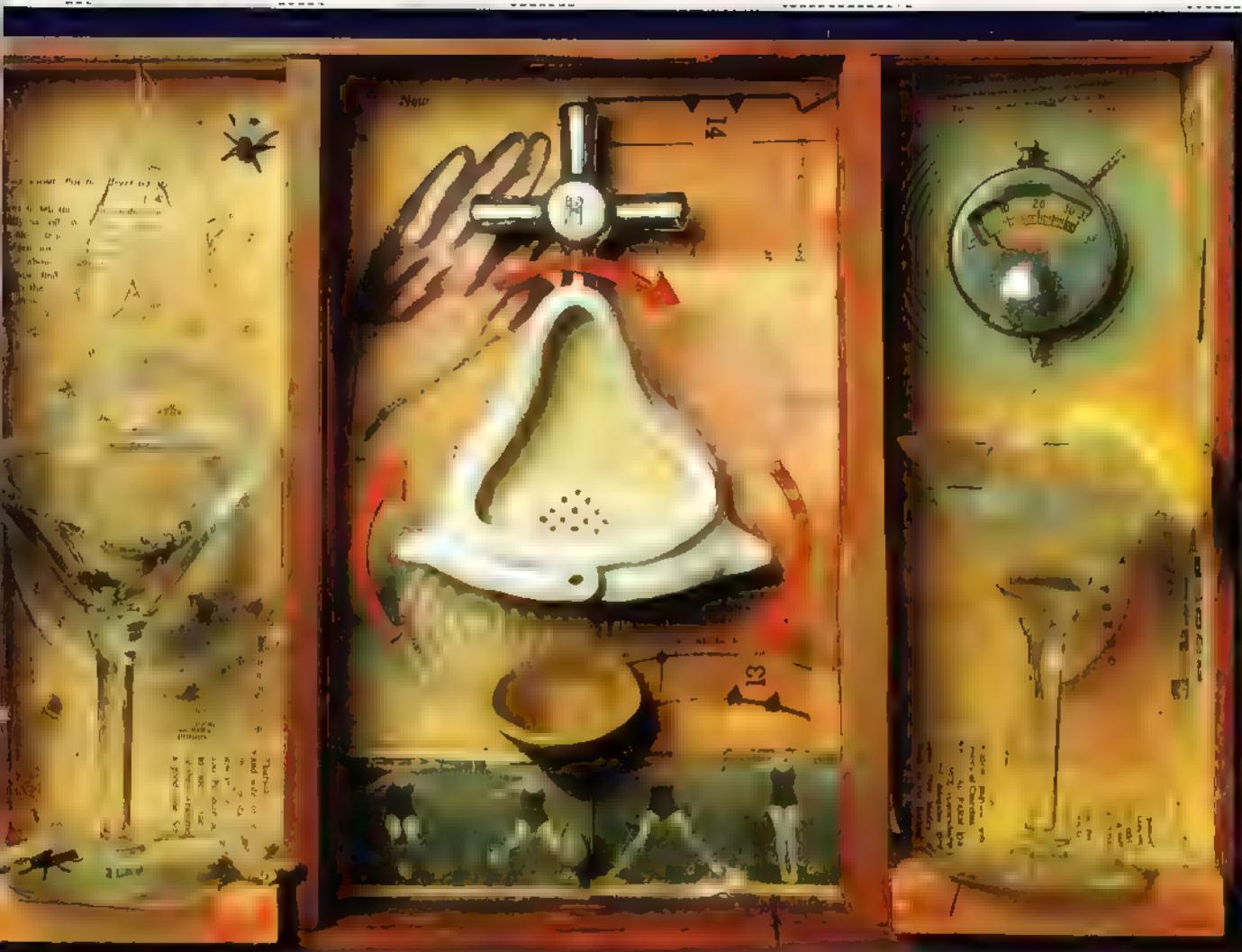
Earlier this year, water-management executives in San Diego and Tampa gave the go-ahead to projects that will take the drinking water these cities now pipe into homes for showering, flushing toilets, and washing

clothes, and they will collect it, purify it, and circulate it back to homes for reuse as drinking water. Seeking to avoid the dreaded term "waste water," acolytes of water treatment call the process "potable reuse." It may well be the ultimate example of closing the loop.

Regardless of its source, most water we now drink has been used many times before. Mississippi River water, for instance, gets spewed out upstream as Natchez, Mississippi's effluent, only to be pumped in downstream as Baton Rouge, Louisiana's drinking water. Other communities repeat the process, right on down to the Gulf of Mexico. Colorado River water that Southern Californians drink is a blend that includes waste water from 187 municipalities. Few officials advocate what's called "direct reuse" — pumping purified waste water directly into home faucets. But many support "indirect reuse" — mixing highly treated waste water with the water in reservoirs.

Despite fears that sewage water may contain infectious and toxic materials, interest in potable reuse is growing for the simple reason that groundwater aquifers are being over-tapped. In 1985, the U.S. Geological Survey estimated that Americans directly consume 338 billion gallons a day of fresh water (an average of about 1,400 gallons a person) for everything from cooling nuclear power plants to brushing teeth. Coupled with estimates that the U.S. population will rise from 249 million people in 1990 to 275 million by the end of the century, it becomes clear that inexorable demand is compelling Tampa, San Diego, and other cities to recycle their waste water.

In Tampa's case, the city's Department of Sanitary Sewers asked the Southwest Florida Water Management District — one of five regional districts charged with preserving and protecting the state's water resources — to fund a \$100 million "new water source initiative." In late March the



ILLUSTRATIONS BY JENNIFER JESSE

district approved a proposed 50 million-gallon-a-day indirect potable-reuse facility, Florida's first. Waste water that now pours into Tampa Bay will undergo advanced treatment and then be pumped into the Tampa Bypass Canal, to supplement drinking water from the Hillsborough River.

San Diego, which transports its water hundreds of miles from the Colorado River, also envisions a nearly \$100 million indirect-reuse facility. The project would be California's first to mix reclaimed water with a surface reservoir. Patricia A. Tennyson, director of public affairs for the County Water Authority, predicts "it's the trend of the future."

As early as 1980, water experts

were already concluding that there was no viable alternative to potable reuse. That year, at an EPA experts' workshop, Kenneth Miller of the engineering consulting firm CH2M Hill opined that "When conservation has been programmed to the maximum, when every conceivable industrial and agricultural reuse has been achieved, when dual distribution systems have been installed wherever applicable, when new sources of water have been explored, the only remaining option will be potable reuse."

FOR CITIES AND STATES INTERESTED IN THIS untapped source, the big question becomes: Is it safe? With remarkable consistency, the answer appears to be

an unequivocal yes. First, potable reuse is already being practiced. Northern Virginia's Upper Occoquan Sewerage Authority began operating an advanced-treatment plant in June 1978. The plant discharges waste water, treated to drinking-water quality, into a 180-million-gallon polishing reservoir, then discharges it into Bull Run, a tributary of the 11-billion-gallon Occoquan Reservoir. Water managers from every state and over 50 countries have visited the facility.

Because Northern Virginia's system is a world model, it's worth considering the technology being used to transform human waste water into tapwater. Described as a "treatment train," purification starts with

# GLOBAL FORECAST: CLOUDIER YET

As if the global-warming picture weren't cloudy enough, new data have scientists scratching their heads. A paper published in *Nature* by John Christy and Richard McNider of the University of Alabama-Huntsville reports that global temperatures have risen just one-quarter as much as predicted by most global-warming models. Using satellite-gathered temperature data, the researchers factored out such effects as the El Niño oscillations in the Pacific Ocean. Nevertheless, their mathematical model failed to yield any substantive sign of global warming.

Scientists are also puzzled by the complete halt in the rise of methane, a key greenhouse gas. A report in *Science* cites one intriguing explanation: a drop in the amount of methane escaping from Siberia's vast, notoriously leaky natural-gas pipelines. "By 1992, engineers might have plugged enough leaks to have ended the methane rise," reports Richard Kerr. Other scientists remain skeptical of the Siberian theory. But whatever the causes of the methane mystery turn out to be, Mr. Kerr reports that they may also account for part of the drop in another greenhouse gas, carbon monoxide, because some CO is produced by the oxidation of methane in the atmosphere.

The *Science* article concludes that a more comprehensive approach to studying the interdependence of greenhouse gases appears inevitable. As Ralph Cicerone, an atmospheric chemist at the University of California-Irvine, laments: "The scope of this [puzzle] is expanding willy-nilly. We really don't have an integrating framework with which to view these things."



conventional treatment to remove and decompose suspended solids and biodegradable pollutants.

The secondary-treatment effluent is then sent for chemical treatment. During this step, a high-energy system mixes the coagulant calcium hydroxide with the effluent, raising the acidity to pH 11.3, a process that destroys viruses and precipitates and coagulates phosphorous, heavy metals, and suspended solids. The pH is restored to neutral (pH 7) by two-stage re-carbonation, and carbonates are eliminated in recarbonation clarifiers. Multimedia filtration, using three filter media of different sizes and properties, removes

the remaining particulate matter. An activated carbon absorption system cuts synthetic organic compounds; ion-exchange reactors extract ammonia and activated carbon particles. Any remaining trace amounts of ammonia undergo breakpoint chlorination, a technique using chlorine to destroy ammonia. Finally, the water is dechlorinated and discharged into the effluent reservoir, from whence it can be released into Bull Run.

Worldwide interest in potable reuse grew in 1984, when Denver built a one-million-gallon-a-day demonstration plant to show the feasibility of direct pipe-to-pipe reuse. Denver's water underwent intense scrutiny, including two-year toxicity studies on rodents, with scientists looking for signs of cancer and reproductive toxicity. Though now mothballed, the plant produced water whose quality equalled or exceeded the quality of Denver's existing water supplies.

San Diego, too, operates a 0.5 million-gallon-a-day research facility: Aqua II, located in Mission Valley. In 1985, a health-effects study was begun that was "designed to determine possible health risks of direct reuse of reclaimed waste water" from the facility. Results from the study found that the risk from Aqua II's water "is less than or equal to" existing water supplies.

With such ringing endorsements, will the public accept reclaimed waste water? As water meters continue to register insatiable demand, the more pertinent question appears to be, do we have any choice?

DAVID CLARKE is the chief editor of *Inside EPA Water Policy Report*. He lives in Bethesda, Maryland.

## WHATEVER HAPPENED TO GREEN MARKETING?

What's the real market for plastic products? While environmentalists are demanding more plastics recycling, consumers are clamoring for "special" colors and "alpine" scents. • A press release from Carlisle Plastics, Inc. emblazons in neon the "greatest growth areas" for the 14,000 types of plastic bags it manufactures. Yellow/lemon-scented trash bags are "selling like tortillas" in Mexico. (New Englanders prefer cranberry-colored bags.) Toys-R-Us has "hot-selling diaper-disposal bags with a baby-powder scent in pink and blue colors." Although some bags contain up to 30% HDPE plastic, recycled content is not a major selling point. "After the green movement stimulated development of plastics containing some post-consumer recyclables, consumer interest started to wane," explains Carlisle Plastics' Dennis Shafer. "Color and scent are used to attract indifferent consumers." • Eschewing the average consumer's extravagance, the White House settles for odorless bags in military colors.



# Is Racism a Factor in Siting Undesirable Facilities?

A disproportionate share of environmental hazards fall on poor and minority communities. But, just as the environmental-justice movement takes center stage, studies place the blame not on racism and discrimination, but on market dynamics. **By Robert Braile**

**P**RAISE FLOWED LIKE A RIVER IN spring when President Clinton signed an executive order in February telling federal agencies they have one year to institute policies that ensure their environmental actions do not disproportionately burden America's poor and minority communities. Mainstream environmentalists were ecstatic: Characterized by some critics as "white middle-class elitists," they had finally found a way to diversify their image and shed the stereotype.

For more than a decade, study after study has concluded that the communities least empowered to fight the siting of waste-to-energy incinerators, hazardous-waste treatment plants, and other risky projects were the very same communities that ended up with them. The federal EPA responded: launching studies of its own, requiring that siting risks to minorities be included in environmental impact statements, and creating an office of environmental equity. A flurry of bills on Capitol Hill, including then-Senator (Tenn.) Al Gore's Environmental Justice Act of 1992, sought to right the wrongs. Cries of racism, however — heard from Chicago's "Toxic Donut" to Baton Rouge's "Cancer Alley" — hadn't captured the national imagi-

nation until Mr. Clinton put pen to paper. Environmentalists and civil-rights activists had found something to unite them.

"Some people were starting to say there is no problem," says Robert D. Bullard, a professor of sociology at the University of California at Riverside who helped shape the executive order as a member of the Clinton transition team. "But here was the President of the United States saying there is. It made me feel good."

Prof. Bullard and other environmental-justice advocates are feeling considerably less pleased in recent months, however, as new research questions the movement's totems. One study even concludes that poor and minority communities are not overburdened with facilities. Other studies concede a disparity, but question whether discrimination is the sole cause — and so whether legislative and regulatory efforts premised on discrimination can solve the problem.

The questions these new studies pose are compelling: Do minority neighborhoods really bear more than their fair share of locally undesirable land uses, or LULUs? If so, is the siting disparity the result of classism and racism, or other influences? Do advocates really want to protect air, land, and water, or just create a new, politically correct strain of NIMBYism?





**"Claiming that it will contribute to the problem of urban pollution, adding carpool lanes on the Long Island Expressway is being opposed by environmentalists. 'Adding carpool lanes is like addressing obesity by loosening your belt,' says David Burwell, president of the Rails to Trails Conservancy."**

(NEWSDAY 5/18/94)

Vicki Been, a law professor at the New York University School of Law, writes in the April issue of the *Yale Law Journal* that the movement has not established whether the communities hosting LULUs were predominantly minority or poor when the facilities were sited. She contends that the movement's advocates failed to consider demographic shifts in those communities after the facilities were sited.

Unlike earlier researchers, Prof. Been relied on census tracts, units used by the U.S. Census Bureau. (On average, the tracts are .74 square miles in size and contain 4,000 people.) She applied census-tract data to two of the major studies that support the movement — a 1983 report by the General Accounting Office concluding that most of the people living near four hazardous-waste landfills in the Southeast were African-American, and a 1983 study by Prof. Bullard con-

cluding that 21 of Houston's 25 incinerators and landfills were located in predominantly African-American neighborhoods. Prof. Been found that the Southeast communities were indeed largely African-American when the facilities were sited, and so discrimination could have occurred there.

In Houston, she found something different. Only about half of the facilities are in communities that were predominantly African-American when they were sited between 1953 and 1978. Only after the incinerators and landfills were sited did the communities experience an extraordinary rise in African-American populations — 223% compared to 7% in Houston as a whole.

Instead of siting discrimination, as Bullard concluded, Been suggests market dynamics played a role, especially through the "come to the nuisance" syndrome, whereby a facility

is sited, property values decline, and the poor (who tend to be minorities) move in. Also, once a facility is sited, wealthier residents (who tend to be white) move out. She says both syndromes suggest discrimination is alive and well in society at large, but that it did not necessarily occur in siting the Houston facilities.

Prof. Been argues that discrimination cannot be proved until such "longitudinal" analysis is applied to the earlier studies. Reforming the siting process along racial and class lines may fail in achieving the equity the movement seeks. "My theory is that even if you could site everything fairly tomorrow, we will still see, ten years from now, that the people who live next to the facilities will be poor and minorities," she explains.

The movement may be resisting such analysis because "it makes things more complicated, and suddenly Clinton's executive order makes less sense," Been adds. "[Advocates] are making a political choice, trying to find good guys and bad guys and keep them identifiable."

Douglas A. Anderton, the director of the University of Massachusetts at Amherst's Social and Demographic Research Institute, took criticism of the movement one step further in a national study published in the April issue of *Evaluation Review*. Prof. Anderton applied census-tract data to the same facilities cited in a landmark study done in 1987 by the United Church of Christ Commission for Racial Justice, which found that communities across the country within zip-code range of at least one hazardous-waste landfill had twice as many minorities as those without

## Woody Loses Some Woods

**• North Carolina timber farmer Ben Cone has a problem. The federal Endangered Species Act prohibits him from disturbing the red-cockaded woodpecker, which is nesting in 1,600 acres of his longleaf-pine forest. But Mr. Cone has devised a solution, sort of. He's clearcutting other parts of his woodland to keep the protected birds from spreading. • In the Southeast, woodpecker-induced logging restrictions fall mainly on private property owners. With landowners losing as much as \$100,000 to protect a single group, they're mad enough to broil the bird. Wildlife economist Webb Smathers proposes a more benign solution: awarding landowners economic credits for allowing the birds to reproduce on their property. "Woodpecker credits," reports the *Los Angeles Times*, "like credits given to businesses for reducing air pollution, could be bought and sold."**



landfills. Prof. Anderton's recent conclusion is stunning. TSDFs, or treatment, storage and disposal facilities, are no more likely to be sited in areas with higher percentages of African-Americans and Hispanics than in other areas. He determined that they tend to be in areas where many industrial workers live.

Are the movement's claims of racial discrimination in the siting of undesirable facilities, then, merely a form of NIMBYism? "You would have to draw that conclusion," Prof. Anderton asserts, "based on how the movement responds to our findings. If the response is to ignore the facts and argue contrary to the evidence, then you would have some evidence of their taking an emotional approach to the issue."

Kent Portney, a professor of political science at Tufts University and the author of *Siting Hazardous Waste Treatment Facilities: The NIMBY Syndrome* (Greenwood Press, 1991) observes that "debate is starting to take place [as to] whether efforts to block facilities using an environmental justice rationale is really just another form of NIMBYism."

Professor Bullard dismisses the NIMBY claims, arguing that, while justice advocates may block the siting of new facilities, they are at the same time forcing society to adopt more environmentally beneficial ways of dealing with waste, such as expanded recycling programs in lieu of garbage incinerators.

Some researchers counter that the movement would deny poor and minority communities the economic opportunities facilities bring; instead of fighting them, say critics, the movement should support ways of compensating host communities with economic incentives paid for by others using the facility. Thomas Lambert and Christopher Boerner, research fellows at the [continued on p.18]

### "GREEN CARS" (June/July '93)

This spring the Environmental Protection Agency fanned the fires of an already heated debate by issuing a preliminary report suggesting that electric vehicles would not outperform their gasoline-powered cousins. Not only would EVs cost more and travel less distance on a recharge, they would fail to eliminate smog-creating emissions, the report concludes. Power plants would take up where tailpipes leave off. • EV advocates such as the Boston-based Northeast States for Coordinated Air Use Management, citing their own studies, criticized the EPA for not obtaining "outside input" and for skewing the data. Among their complaints: The EPA overestimated EVs' energy consumption by up to 130%, and overstated the utilities' nitrogen-oxide emissions by as much as 300%. The *Wall Street Journal*, on the other hand, reported concern from auto-industry executives that the study "doesn't go far enough to discredit electric vehicles." • Peter Cafrey, an EPA engineer who helped crunch the numbers for the controversial report, is busy reading a pile of critiques to prepare for the agency's summer workshop on creating a better methodology for analyzing EV impacts.

### "IS RECYCLING SUCCEEDING?" (June/July '93)

"Flow control," the practice of requiring by city law that all of a municipality's garbage and recyclables go to a favored disposal site, was overturned by the U.S. Supreme Court this past May. In a six-to-three decision that struck down a flow-control ordinance issued by Clarkstown, N.Y., the Supreme Court ruled that flow-control laws unconstitutionally interfere with interstate commerce. • Recycling acolytes have long argued that flow-control often results in monopolies, whereby one hauler and one facility is awarded exclusive franchise to all of a city's trash. Kendall Christiansen of Brooklyn's Star Recycling, Inc. hailed the court's ruling, telling the *Journal of Commerce* that the decision "is clearly in favor of market forces and the efficiencies that come

with the [free] market." • Some garbage gurus view the ruling as a setback for trash-to-energy plants, which rely on flow-control laws to ensure a high-volume of waste—as well as their economic viability. In a separate decision that will also affect the bottom line for incinerators (although no one can predict how much), the Supreme Court ruled in May that garbage burners cannot bury hazardous ash in MSW landfills.



# PRESS CLIPS

FROM OUR COLLEAGUES IN THE MEDIA

## Radiation Fallout

EILEEN WESOME, A REPORTER FOR THE Albuquerque Journal, a small afternoon daily, in April scored journalism's biggest prize, the Pulitzer, for her report on human experimentation in radiation research during the mid-1940s. Welsome spent six years sleuthing the identities of five people, all dead, who unknowingly were injected with plutonium by Manhattan Project scientists. Her riveting account amounts to gumshoe reporting at its finest.

The series spawned a frenzy of follow-up articles from the nation's press. A cover story in Newsweek, "America's Nuclear Secrets" (Dec. 27), told of tests on "human guinea pigs" and quoted Energy Secretary Hazel O'Leary comparing scientists who conducted the experiments to Nazis.

Washington Post columnist Jessica Matthews milked the story for its pathos, reporting that the experiments were "all done on people the Atomic Energy Commission considered disposable: prisoners, mental patients, indigents...." The "me-too" articles were accurate. They just didn't tell the whole story.

The truth is "more complex than this sensational picture," asserts an article in *Science* titled "Radiation: Balancing the Record" (Jan. 28). Science writer Charles C. Mann combed through a widely (and wildly) cited congressional report cataloging 31 ra-

diation experiments on humans during the Cold War. He reports that experiments such as those depicted by Eileen Welsome were indeed blatantly unethical. But nine other tests, which introduced minuscule amounts of short-lived radioactive tracers into human subjects to follow biochemical reactions, constitute an apparently safe biomedical technique still practiced. And in five additional experiments, the "human guinea pigs" were neither prisoners nor mental patients — they were the researchers themselves.

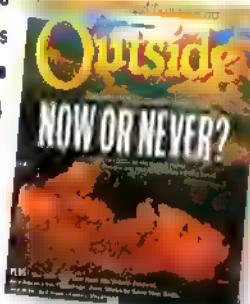
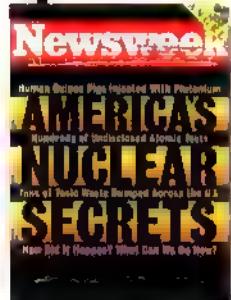
Richard Harris, science editor of National Public Radio, also criticized the stories. Among the problems, outlined in the Spring issue of *Science Writers: Reporters confused ra-*

*diation-tolerance experiments with research using radioactive tracers; they overlooked dosage; many repeated the "demonstrably false" statement that plutonium is one of the deadliest substances known. "The hazard of plutonium," writes Mr. Harris, "isn't much different from the hazard of ... the americium in your smoke detector."*

## Shootout in Silver Canyon

IN THIS ERA OF DIPLOMACY, WHEN ENVIRONS and industry-types often work together, an unflinching story in *High Country News* serves notice that not everyone is open to compromise.

The place is Silver Canyon, part of the Gila National Forest in New Mexico, which is "dying" due to overgrazing by cattle. The protagonists are Susan Schock, head of a grassroots group called Gila Watch, and Kit and Sherry Laney, ranchers who lease grazing rights to the canyon from the U.S. Forest Service. At issue, reports Tony Davis in "The Struggle for the Last Grass" (May 2): Environ-



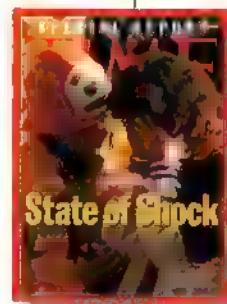
**OUTSIDE GOES INSIDE** — Back in September 1990, when we were being deluged with "too damn many copies of '999 Simple Things You Can Do to Embrace the Planet,'" *Outside* published an article that dared take on the greens. By turns catty (a typical member of the National Wildlife Federation "received most of his outdoors knowledge watching *Grizzly Adams*") and cognizant (NRDC's "unmarked donations may disappear into overhead"), "Inside the Environmental Groups" made good on its bid to "make us a little less accepting, a little more informed." ■ The article worked so well, *Outside* recycled the idea in its March '94 issue. "Inside the Environmental Groups, 1994" this time presents a more sober view of activists. Hardliners such as Earth First!, Rainforest Action Network, and Citizens Clearinghouse for Hazardous Wastes failed to make the cut for the "most prominent" environmental groups. The Environmental Defense Fund, whose free-market environmentalism landed it in bed with George Bush in the '90 original, is now lauded for its "capitalist-friendly environmentalism." ■ Thankfully, the grownup *Outside* can still cast a wry eye on the eco-scene. While "Inside '94" doesn't identify the group that's lost one-third of its budget, it does offer up a hint: The name rhymes with "spleen-cease."

**A KISS FROM THE AP** — The photographer they sent to Gloucester expressed disappointment at the sturdy National Register brick building built in 1810, at the Georgian woodwork in my office and the oriental carpets in our library. Lips pursed, he shook his head. "This is not what we want. This looks like New York!" ■ He asked if he could look around, and I left him to his pursuit. In a few minutes he came and got me. "I found it," he said, leading me to the stockroom. A joke, of course: no windows, too many unpacked boxes, and a carpet stain from the previous tenant. I laughed. He said, annoyed, "No, this is it, we could sort of set up an office in here with a lot of papers, and you'd look like you're just hanging on." ■ Perhaps you saw the story, which reported the demise of "green" magazines. It went out on the Associated Press news wire in late March, and was widely picked up. ■ The article's account is hard to dispute: Environmental publications founded in the past six years have not enjoyed wide consumer-audience acceptance and are unprofitable or out of business. A story worth telling; as the article pointed out, the "fall-off in environmental interest [has] implications beyond the publishing industry." ■ The article's negativity was no surprise. Nevertheless, a complicated, potentially instructive business and environmental story had been homogenized into a vaguely sarcastic parable: The publishers were greenies in it to save the Earth, and have found to their surprise that it's hard to make a success of an enviro mag and so they're all bankrupt or close to it. Naivete punished, idealism crushed. Oh — and score another point for the environmental backlash. Told you nobody cares. ■ "They harbored dreams of spreading the green gospel," the AP article opened. Antithetical to GARBAGE — but an inspired set-up for the moralistic tale that followed.

— PATRICIA POORE

mentalists, led by Schock, want the Forest Service to protect the canyon by rescinding grazing permits — which might destroy the livelihood of ranchers, personified by the Laneys.

The story avoids stereotypes. Schock is a rancher's granddaughter whose last-stand attitude alienates middle-of-the-road environmentalists, who in her view "have no balls." The Laneys live off the land and off the grid, and consider ranchers "too wimpy" in their dealings with regulators and enviros. The Forest Service is caught trying to appease both sides. "What everyone wants is to make everybody happy," says Schock, "and everybody isn't going to be happy over this."



EVER ON THE LOOKOUT FOR ECOLOGICAL Armageddon, *Time* reports that the past winter's freeze-up may signal that an Ice Age is upon us. Here's the gist of "The Ice Age Cometh?"

(Jan. 31): "If last week is any indication of winters to come, it might be more to the point to start worrying about the next Ice Age. The last one ended about 10,000 years ago; the next one ... may have already started." [my emphasis]

But does a season's shift in weather patterns equal a profound change in climate?

This isn't the first time *Time* has taken such a tack. Just five years ago the newsweekly was in a sweat over global warming. "What on Earth are We Doing?" (Jan. 2, '89) announced:



"This year the earth spoke, like God warning Noah of the deluge. Its message was loud and clear ... A stubborn seven-week heat wave drove temperatures above 100 degrees F across much of the country, raising fears that the dreaded 'greenhouse effect' — global

warming as a result of the buildup of carbon dioxide and other gases in the atmosphere — might already be under way." [my emphasis]

Can *Time* have it both ways? Absolutely. The beauty of describing a scenario is you can make it alarmist enough to grab readers, yet no one can refute it with certainty.

## For the Record

\*\*\* "Environmental Lobby Beats Tactical Retreat" is the headline for a *New York Times* article (March 30) on how environmental groups are reeling after they rushed to embrace the Clinton Administration, which has taken a soft stand on conservation issues. The *Times*' editors, apparently deciding that such news was pretty piddling, buried the story on page seven of the Metro Section.

\*\*\* It was the shot heard 'round the recycling world: In September 1990, the Maine Legislature banned aseptic packaging. Morning network news shows covered drink boxes being pulled from store shelves. "America is haunted by a tainted environment and, with it, the specter of juice box packaging," howled the Worthington, Minn., *Daily Globe*.

This past April, Maine legislators discovered that drink boxes take up just 0.03% of the state's waste stream, and repealed the ban. The *Wall Street Journal* was the only major paper to run the story. Apparently, drink boxes were newsworthy for only as long as they symbolized ecological crisis. Once the "crisis" was unmasked, the symbol was as disposable as a Pampers. — BILL BRENN

# THE TAB FOR CLEAN TAP WATER

• To remedy the huge financial burden imposed on states by the federal Safe Drinking Water Act, the U.S. Senate voted in May to reduce the number of contaminants covered by the law. Under current regulations the EPA sets standards for 84 contaminants, ranging from volatile organic chemicals to pesticides. The Senate's new statute would have the agency regulate only the 15 "most dangerous" substances in drinking water. • The Senate's changes spring from concerns that most states lack the funds to meet minimal clean-water requirements. In 1992, Maine's Commissioner of Human Resources received a written reprimand from the EPA because the state could afford just eight full-time employees to oversee water quality. (Most Maine-sized states employ 20 to 30 regulators.) The Senate rewrite also includes a \$1 billion annual-loan fund to help local water systems meet the standards. • Environmental groups, who believe the Senate is attempting to solve a funding problem by weakening clean-water standards, are turning to allies in the House for help in passing a tougher bill. *Greenwire* reports that environmentalists view the measure — "the first environmental statute facing a congressional vote since President Clinton took office" — as a test of the Clinton Administration's environmental commitment.

Center for the Study of American Business at Washington University, have gone so far as to criticize the movement for paternalism. Prof. Bullard refutes the point: "Those people say the facilities are the best thing since white bread, but they don't live near them."

He's taken issue, too, with Been and Anderton, blasting their use of census tracts. The tracts were created in 1950, and so ignore prior facilities and the siting discrimination that may have occurred, he

says. In Houston, Prof. Bullard used instead "neighborhoods" — communities that may have existed for a century or more, which are smaller and more homogeneous than census tracts. Been and Anderton counter that neighborhoods are vaguely defined and statistically unreliable. But Prof. Bullard insists they provide a truer sense of who is affected.

Besides, the movement is focused on more than siting problems, says Prof. Bullard. It is tackling

such hot-button issues as Superfund reform and childhood lead-poisoning prevention; it's pushing for stricter compliance with existing laws, from the 1969 National Environmental Policy Act to the 1964 Civil Rights Act. He says a key 1992 *National Law Journal* report makes it especially clear that enforcement must be a top priority. Among other findings, the *Journal* article concluded that hazardous-waste penalties against polluters of white communities were 500% higher than against polluters of African-American communities; that environmental penalties were 46% higher in white communities; and that abandoned Superfund sites in minority areas take 20% longer to clean up than those in white areas.

"To try to reduce everything to siting and race is to try to narrowly define the environmental-justice movement, to make it a black-and-white thing so you can dismiss it," says Prof. Bullard. "It would be like limiting the civil-rights movement to food stamps."

But to Vicki Been, the movement's advocates are reducing environmental justice to a racial issue. "Right now, the movement is heavily focused on race, and spends a great deal of time trying to prove that [siting undesirable facilities is] race-based," she says. "But, if ten years from now we find that undesirable projects are located in white neighborhoods, will we really have advanced?"

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ROBERT BRAILE, a correspondent for The Boston Globe, reports on environmental issues throughout New England.



"Controversial plans for a twin reactor at the nuclear power plant in Suffolk, England, recently won the support 'of an unlikely source and for an unlikely reason: the Royal Fine Art Commission, on aesthetic grounds.' The commission said three nuclear domes off the scenic British coast will look better than one."

FINANCIAL TIMES 5/20/94



# AT ISSUE

If anything ties these features together, it is technology: technology under attack (in the stories about chlorine and bovine growth hormone), technology providing environmental solutions (drugs from bugs and the latest toilets), technology that answers the wrong question (compact fluorescents). Prominent, too, are the politics of public persuasion.

These stories are hot issues in environmental debate. The editors hope, however, that the depth of coverage here puts each story in wider perspective. Compact-fluorescent giveaways would be as sensibly covered in an economics article on the pitfalls of demand-side management. Despite inflammatory opposition, rBGH is not a public-health threat; it deserves debate, however, in any discussion of the existing milk surplus, rising efficiencies, and federal subsidies for dairy operations.

## ■ Drugs from Bugs by Carol Kaesuk Yoon (page 22)

Carol Yoon holds a PhD from Cornell University in Biology and Evolutionary Biology, and a B.S. in Biology from Yale College. Dr. Yoon contributes regularly to the *New York Times*, the *Washington Post*, and the *Los Angeles Times*, as well as *Science* and *Earth Magazine*. Recently, she was a Visiting Scholar at Cornell's John S. Knight Writing Program.



### ◆ ARTICLE SUMMARY

To thwart a serious decline in the world's biodiversity, conservationists are launching an ambitious quest to inventory countless numbers of species, in the hope that some may produce the chemical building blocks that could yield multi-million dollar pharmaceuticals. In effect, con-

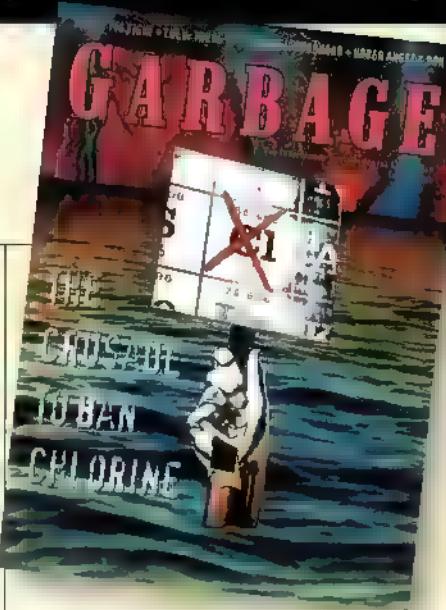
servationists are attempting to market biodiversity to save it.

In Costa Rica's rainforests, biologists and amateurs have collected over a million specimens. Given that the 20 top selling drugs are derived from natural sources, the promise of the alliance struck by Costa Rica and the Merck pharmaceutical company may be realized.

Critics say that Costa Rica has done little more than amass a huge pile of unidentified animals and plants. The probability of discovering and developing a marketable compound is about one in 10,000.

### ◆ AT ISSUE

Species inventories may be profitable in theory only; economists question whether in practice it is more profitable to farm or log the same land. Most agree the selling of conservation for profit is risky. If the tack were to fail, it could further damage the image of conservationists.



## ■ The Crusade to Ban Chlorine by Ivan Amato (page 28)

Ivan Amato is a science writer whose work has appeared in the *Los Angeles Times*, *World Book's Science Year*, *Chemistry and Industry in Britain*, and a host of science and chemistry publications. He has held staff positions at *Analytical Chemistry*, and *Science News*, and, most recently, as a writer for *Science* magazine (AAAS).



Mr. Amato received a degree in chemistry and a masters in the history and philosophy of science at Indiana University. Practical experience includes lab work at the Exxon Research and Development Corp.

Currently, Ivan Amato is working on technology commercialization issues for the National Institute of Standards and Technology, and writing a book on the history of materials research for Basic Books. He is based in Silver Spring, Maryland.

### ◆ ARTICLE SUMMARY

This report examines the dead-serious proposal, spearheaded by Greenpeace, to eliminate or dras-

tically curtail the industrial use of chlorine — critical in thousands of processes and consumer products. "There are no uses of chlorine we regard as safe," states a Greenpeace research analyst.

"Patently ridiculous and scientifically indefensible," counter chemists. Chemists and toxicologists point to the many benefits chlorine chemistry has brought to society and especially to human health.

But industry probably can't count on scientific arguments. Already, EPA's Carol Browner wants a "national strategy for substituting, reducing, or prohibiting the use of chlorine." The Chemical Manufacturers Association, Dow, and others have responded, but their defense doesn't have the emotional appeal of Bella Abzug, whose public endorsement of the proposed ban implied that she blames her own breast cancer on environmental threats including chlorine.

The controversy dates to the 1960s with the pesticide DDT. The notoriety of chlorinated compounds DDTs and PCBs compounded chlorine chemistry's sinking reputation. Most chlorinated compounds have never been implicated as threats, but activists have begun to "connect the dots" between the notorious actors and all chlorinated compounds. They demand that all be considered a single class of chemicals subject to sweeping regulation.

The activists' "precautionary principle," while simple to articulate and seductive, will have to be weighed against costs and benefits to society. For example, Greenpeace's insistence that substitutes exist for chlorinated compounds is misleading. A ban, say chemists, would push alternatives that are truly detrimental to workers, human health, or the environment. Many chlorine-based technologies are in fact replacements for nastier processes of the past.

So far, neither the EPA nor Envi-

ronment Canada has accepted the notion that all chlorinated compounds should be regulated or phased out as a single class. But the effects of the public-relations campaign are already being felt. Big companies are seriously considering substitutes and have their own partial phaseout plans. User groups, such as builders, are reacting by questioning continued use of such materials as PVC. And, while many chemists and toxicologists are incredulous that a ban proposal could really be taken seriously, piecemeal phaseout plans are already coming to light in legislatures.

#### ◆ A T I S S U E

Scientifically, what's at issue is the unprecedented suggestion that tens of thousands of compounds, with no more in common than the presence of chlorine in their molecular structures, be considered a single class for regulation. Would acceptance of the notion embrace environmentalists' do-no-harm "precautionary principle" — with repercussions for other chemicals, technologies, and industries?

Socially, the issue is balancing the benefits of a chlorine phaseout or ban against its risks and pricetag.

#### ■ Udder Angst by Dan Kennedy (page 46)

Dan Kennedy is news editor of the *Boston Phoenix*, New England's largest weekly newspaper. He has written about science, technology, and the environment for more than a decade. His work has appeared in the *Utne Reader* and *MediaCulture Review*.



#### ◆ A R T I C L E S U M M A R Y

Led by Jeremy Rifkin, head of the Pure Food Campaign, environmental activists across the country have mobi-

lized against the use of recombinant bovine growth hormone (rbGH), a genetically engineered copy of a cow's natural GH that reportedly increases milk production by 10 to 20%. Monsanto, the St. Louis-based chemical giant that manufactures rbGH, is fighting back with lawsuits against any retailer who claims its "rbGH-free" dairy products are more healthful than those made of milk from rbGH-treated cows.

Activists have raised concerns about the potential effects of rbGH on both cow and human health. They also claim that rbGH is likely to accelerate the trend toward intensive factory-farming practices that cause soil and water pollution. Perhaps their most compelling claim is that rbGH is not needed, since the nation already has a surplus of milk.

Proponents counter that the dairy surplus is the result of federal subsidies that artificially prop up dairy prices. In a true market economy, rbGH would drive prices down by making milk production more efficient. They point out the federal Food and Drug Administration has found no difference between milk from treated and untreated cows.

#### ◆ A T I S S U E

Activists seem motivated more by a bias against technology in general and genetic engineering in particular. The dairy hormone represents the first skirmish in a battle over bioengineered products, which some fear carry the potential to contaminate the food supply in unpredictable ways.

After investing in rbGH, Monsanto isn't going to back down — particularly since the dairy hormone is just the beginning of what Monsanto and other biotech companies believe will be a multi-billion dollar world market for genetically engineered foods. Despite no firm evidence showing that rbGH causes health problems in humans, opponents thus far appear to be winning the public-relations battle.

## The CFL Boondoggle

by Andrew Rudin  
(page 46)

Andrew Rudin is project coordinator for the Interfaith Coalition on Energy (ICE) in Philadelphia, whose mission is to help congregations reduce the cost of operations with the goal of freeing up money for community service while practicing environmental stewardship.

Mr. Rudin is vice-chair of the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) committee establishing energy-conservation standards for existing buildings. He has trained energy technicians and authored over 100 articles, chapters in books, and papers. Prior experience included over a decade in design, construction, and renovation with emphasis on energy-efficient construction.

### ARTICLE SUMMARY

Using ratepayer money, utilities continue to promote compact-fluorescent lamps as a direct replacement for incandescent bulbs. The programs seem correct enough; environmentalists, especially, herald the promotion of "green lights" that "save" electricity, as well as the concept of "negawatt generation," or increased capacity through conservation.

Fluorescent light, as such, has needed no subsidy; it was introduced in 1938 and a smashing success by 1941, especially for commercial lighting. By comparison, during a period of subsidized CFL promotion by utilities and environmentalists (1986-1991), the typical household did add an additional fluorescent lamp. At the same time, the average household added seven incandescent types of lamps. We have missed the goal of reducing the prevalence of incandescent lighting, says the author.



Turning off an incandescent lamp is about 30 times more beneficial than replacing it with a CFL. In addition, CFLs have their own environmental impact.

The author describes why the bulbs have not found their market. (Of those given away to utility customers, 25 to 50% are removed by homeowners who claim they are too dim, too heavy, too expensive to replace, and too odd. "Satisfied" users rate them poorly on eight attributes.)

Rebates, lamp rentals, and give-away programs actually decrease market acceptance, discouraging purchase and brand loyalty. Furthermore, subsidy has kept the lamps from appearing on store shelves.

The author warns that efficiency often leads to increased consumption unless the articulated goal is less use, rather than efficient use.

### AT ISSUE

The issue here is not the effectiveness of the lamps; their attributes and weaknesses are self-evident. The question is whether ratepayer subsidy is an effective use of promotion and money. It cannot be demonstrated that years of subsidy have overcome market barriers. Moreover, promoting efficient use may miss the point of conservation, or less use, of energy.

### COUNTERPOINT (p. 51)

Countering Mr. Rudin's position is Bill Orthwein, a resource specialist at the Energy-Efficiency and Renewable Energy Clearinghouse in McLean, Virginia. (EEEC is a subcontractor to the Department of Energy.) He defends CFL promotion on the basis of their longer life and energy efficiency as compared to incandescents. He says that utility programs, by creating demand now and general market awareness, accelerate the investment that will improve CFL technology.

## Building a Better Toilet

by Robert Kourik  
(page 52)

Robert Kourik was a member of the Santa Barbara County technical committee that drafted the country's first gray-water ordinance. He is a landscape architect and author of *Gray Water Use in the Landscape and Drip Irrigation for Every Landscape and All Climates* (Metamorphic Press), and co-author of *The Naturally Elegant Home: Environmental Style* (Little, Brown & Co.).



### ARTICLE SUMMARY

Federal law makes it illegal to manufacture the conventional toilet found in almost every American home. Legislation to promote water efficiency is ushering in toilets that consume no more than 1.6 gallons per flush.

In recent years, plumbers predicted clogged toilets and plugged sewer lines. Enviro's painted a picture of tremendous water savings and no mechanical problems. This report shows how toilets conserve water, and offers consumer information on 11 ultra-low flush models.

### AT ISSUE

Do they work? Yes. User surveys contradict critics who assumed that a lower rate of water consumption would result in poor performance. Direct savings in water and sewer bills can equal a one-to-three-year pay-back on the cost of installation.

## Coming Next Issue

**Backlash Perceptions** In "Backlash: Professional Environmentalists Ponder the Growth of Opposition," Robert Braile of the *Boston Globe* gives us the perspective of environmental leaders on their perception of growing anti-environmentalist sentiment, including what they term "stolen rhetoric."

IN AN EFFORT TO PRESERVE THE BIODIVERSITY OF  
RAINFORESTS, CONSERVATIONISTS — FROM HOUSE-  
WIVES TO BIOLOGISTS — ATTEMPT TO HARVEST  
MEDICINES FROM COSTA RICA'S FLORA AND FAUNA

BY CAROL KAESUK YOON

ILLUSTRATION BY BRAD HOLLAND

# drugs from bugs

IN NORTHERN COSTA RICA ON A WARM, MOONLESS NIGHT, TWO MEN STARE INTO THE GLOW OF A BLACK LIGHT reflecting off a sheet that flutters in the breeze. Attracted by the light, hundreds of brightly colored moths, beetles, and katydids descend from the darkness. A few dangle brightly from the surrounding tree branches, lit up like sparkling Christmas ornaments. The men grab excitedly at this one or that, turning the tiny beasts over in their hands. The insects are the gold these prospectors have come in search of, the treasure they believe may be the best hope for protecting the world's dwindling diversity of species. Among the finds this night is a regal moth, believed to contain chemicals that could yield valuable pharmaceuticals. The insect is deposited amongst the other living loot. ¶ This same evening, nearly sixty other farmers, fishermen, housewives, and students likewise scour the Costa Rican countryside, collecting all manner of known and unknown species: spectacular monkey pot trees; stilt rooted *Iriartea* palms; dull brown moths as yet unnamed; one of the last red eyed tree frogs known to inhabit Costa Rica. ¶ These men and women are not driven by some esoteric scientific question. Rather, they search in the hope that some species will carry the chemical building blocks that could yield drugs, perfumes, glues — any number





of products valuable enough to protect the forests these species inhabit. The collectors aim, they say, to make the overflowing diversity of their nation's species its most profitable resource. And although no cure for cancer or AIDS has yet come from these forests and fields, the promise that Costa Rica's vast array of untapped species could produce such a billion-dollar drug has prompted international pharmaceutical companies to make million-dollar investments in this intensive species quest.

For conservationists, what fuels these efforts is the fear that "biodiversity" — a newly popular term that describes all aspects of biological diversity, including all the world's species as well as their genes, interactions, behaviors, and even the ecosystems they comprise — is taking a fast and furious nosedive. Hard data on the number of species lost each year are impossible to come by. Many species remain undiscovered, and there are no reliable figures on the rates of habitat destruction. The best anyone can give is a rough estimate of extinction rates.

But even conservative estimates show the situation to be bleak.

**Tropical treasure hunt:** Felipe Chavarria, a veteran species hunter with Costa Rica's National Biodiversity Institute, uses a net to capture moth larvae in the forest canopy (top left); at night, he shines a light on a white sheet to attract three specific species of moth (bottom left). Prospecting is not for the faint of heart: Felipe bags some killer bees (right). At the Institute's headquarters, the booty is catalogued.



Edward O. Wilson, an evolutionary biologist at Harvard University, describes the state of the state of knowledge of species extinctions in his acclaimed book *The Diversity of Life* (Norton, 1992). Due largely to logging and clearing for agriculture and human habitation, Dr. Wilson believes more than half of the world's tropical rainforests, thought to contain more than half of all the world's species, had been destroyed by 1989. Rainforests continue to be cleared at the rate of one football field per second, or an area the size of Florida each year.

Dr. Wilson reckons that this translates into 27,000 species of flora and fauna that are driven to extinction each year, or 74 species lost each day. These

figures do not include the uncalculated numbers of species thought to be lost each year due to overharvesting, pollution, and the havoc wreaked by invasive species. In his study of extinction rates published in *Science* ("Extinctions: A Paleontological Perspective," August 16, 1991), David Jablonski, a paleobiologist at the University of Chicago, figured the current die-off to be one of the greatest mass extinctions this planet has experienced.

## Biodiversity for Humans

FOLLOWING YEARS OF WARNING THE PUBLIC of the aesthetic poverty of a planet without jaguars or toucans, conservations are changing their tune. Striking an unexpectedly popular chord, they no longer ask what the public can do for endangered species, but rather what such species might do for the public. Biodiversity, we are to understand, is a potential cornucopia of genetic material that will produce precious drugs and food, as well as a source of money, jobs, and better living. If biodiversity is going to do all that, of course, we've got to keep it alive.

To protect the world's remaining habitats, conservationists are touting the economic value of species known and unknown. In effect, they are attempting to market biodiversity to save it. Costa Rica is ahead of the pack in a global bid to turn profits from the promise of its biodiversity, but the country is far from alone. As this new species-for-dollars movement catches fire, additional nations announce national biological inventories, the most recent additions being Mexico, Taiwan, India, and the United States. The most ambitious venture may be Systematics Agenda 2000, a global effort spearheaded by the world's foremost systematists — experts in species discovery and identification. Their aim is to rally funds and scientists to discover and learn the relationships of all — that's right, all — the world's species, seeking out those organisms that could improve and sustain the quality of human life.

## Success: One in Ten Thousand

IN THE NORTHWESTERN CORNER OF COSTA Rica, just below the Nicaraguan border, lies Santa Rosa, the National Conser-

vation Area, so far best developed in Costa Rica for biological surveys. It provides a closeup of the inventory. Hundreds of tiny plastic bags hang from the wooden rafters under a tin roof. Between the deafening pings of rain hitting the rooftop, women at picnic tables shout out descriptions of caterpillars in the bags and the plants the caterpillars are eating. Soon Felipe Chavarria drives up to show off the day's bounty: a nest of vespid paper wasps and a bottle containing an eyelash viper — a powerfully venomous snake that kills several Costa Ricans each year. He had been searching for both species, as their venoms are potentially valuable chemical sources.

Felipe is one of the species hunters

\* \* \* \* \*

Chemical prospector Elda Araya Martinez sweeps plants for insects in Costa Rica's Santa Rosa National Park (center); nighttime is the right time for catching scorpions (top left). Venoms of insects and snakes are potentially valuable chemical sources for pharmaceuticals. At last count, the National Biodiversity Institute had amassed 1.3 million specimens of insects and 55,000 specimens of plants, which are marked with bar codes.

with the National Biodiversity Institute, whose Spanish acronym is INBio. Questioned about their hunt, Chavarria and the others are cautious with their words and wary in their glances. Because of the potential for making millions of dollars from even a single successful pharmaceutical, everything from the search for chemically rich species to the nitty-gritty lab benchwork of isolating and testing the chemicals is shrouded in secrecy.

Ana Sittenfeld, director of biodiversity prospecting at INBio, allows that collectors often look for species known to carry biologically powerful chemicals, like venoms. But they also prospect for organisms whose interrelationships with other organisms merely hint that they may carry useful chemicals. For example, the search for an anti-fungal agent might well begin with a plant whose fallen leaves never sprout a mold during decomposition.

Once collected and identified, the most promising specimens are ground up into "soups" and sent off to pharmaceutical companies such as Merck & Co., where they're carefully screened for their ability, say, to kill



fungi, or bacteria, or viruses.

"Let's say Merck gets a positive result in an anti-fungal test," says Dr. Sittenfeld. "Then the separation process starts. Which chemical compound among the thousands in the specimen is responsible for the [anti-fungal] activity? That takes a year to determine, if you're lucky. Then you need to find out if the compound is new or already on the market; how soluble it is; whether it's non-toxic. Then you'll need to modify the structure, because it will need lower toxicity or increased activity; then it will go into animal tests, then clinical tests, and then be submitted for FDA approval."

The probability of discovering and developing a marketable natural compound is about one in ten thousand. The whole process could easily take ten years. But because profits from a new compound can be in the tens of millions annually, it's a chance many drug companies view as worth taking. In a highly publicized deal, Merck paid \$1 million to fund INBio's conservation and research, in exchange for a first-chance look at the "soups" of an undisclosed number of species. The deal, which was brokered in 1991, has not yet produced results. But Merck and INBio are hoping that the arrangement may yet culminate in a product.

There is some reason to believe the promise of such industry/conservationist alliances will be realized. As scientists explain, Nature's pharmacopoeia of plants, microbes, and animals already has a well-proven track record for producing medicines. The painkiller codeine comes from the opium poppy; digitoxin, a cardiac stimulant, is derived from common foxglove; ergonovine, which controls hemorrhaging and eases migraine headaches, comes from a plant fungus known as smut-of-rye; the Pacific yew tree is the source of taxol, an anti-cancer drug. In fact, today's 20 best-selling drugs — worth some \$6 billion a year — are derived from natural sources.

Agriculture has only begun to tap the benefits of biodiversity. During an Andean expedition in 1962, Hugh Iltis,

a botanist at the University of Wisconsin, picked up a "worthless weed." Subsequent study revealed that this "weed" was a new species of wild tomato which, when crossed with cultivars, dramatically increased their sweetness. "The genes from this one species have been estimated to increase the value of the California tomato crop by \$20 million a year," says Dr. Iltis.

Likewise, scientists say, many more plant and animal species could be added wholesale to the short list of organisms that humans currently raise for consumption. Edward O. Wilson estimates there are 30,000 species of plants with edible parts. A mere 20 species currently provide 90% of the world's food. Three species — maize, wheat, and rice — together account for more than 50% of what we eat. When we do enjoy variety, scientists tell us, we can thank biodiversity.

## Nowhere Are All Species Known

AS INVENTORIES GET UNDERWAY WORLD-WIDE, INBio's trailblazing makes it clear that efforts to take stock of the species in biodiverse countries face roadblocks. To date, there is no place on Earth in which all the species are known.

Picture the problem of trying to discover all the species in even a few square miles of a Costa Rican preserve. Costa Rica, though less than half the size of the state of New York, is home to an estimated 5% of all the world's species. In this wildness, hummingbirds fashion their nests on the dangling threads of spiderwebs, beetles twinkle in the trees like polished dabs of silver, butterflies masquerade as leaves, lizards walk on water, and snakes swim in the sea.

Certain groups of animals and plants are already extremely well documented in Costa Rica, particularly those species which are beautiful (and catchable) enough to make them the object of collectors. Institute Director Rodrigo Gamez reports that the birds, mammals, fish, amphibians, and reptiles of Costa Rica are essentially 100% collected and catalogued. "It was an idea whose time had come," he says.

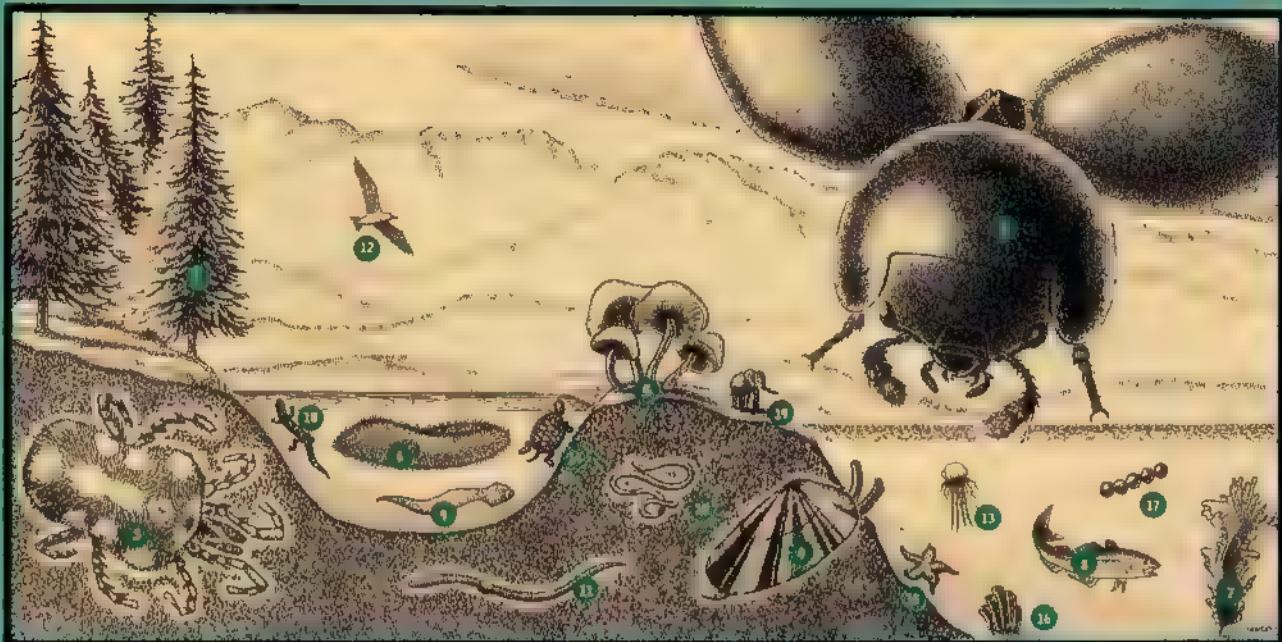
Perhaps so, but the hard part has just begun. Completing the inventory means filling the gaping holes in the world's shockingly spotty knowledge of its creatures and plants. Biologists say that a single handful of dirt from anywhere in the world will yield thousands of new species of bacteria, viruses, and round worms. While these creatures may be less aesthetically appealing than a sapphire-throated hummingbird, in all likelihood they are more economically important. INBio is now searching for the species hardest to inventory but most likely to carry the stuff of discovery. Fungi, for example, whose trailing rootlike systems weave together underground and may sprout a mushroom only once in a human generation, make clear the obstacles in an inventory of all biota.

It is the invisible world of microbes that has given us more than 3,000 antibiotics, including the penicillin that has saved countless lives. Viruses and bacteria comprise the backbone of the biotechnology industry. No life-saving products have been derived from such "charismatic megafauna" as snow leopards and bald eagles, although they may symbolize conservation.

In Costa Rica, some 60 collectors are out scouring the countryside for new species every day, sometimes 18 hours a day. Specimens are piling up. At last count, INBio had amassed 1.3 million specimens of insects and 55,000 specimens of plants. Despite these large numbers, so far just 65,000 out of an estimated 225,000 insect species have been found and identified. Such perseverance has allowed INBio to reap benefits unavailable to "one-shot" inventories, typically conducted in the tropics by visiting American or European scientists whose short tenure leaves many species wholly unknown. Unlike the rapid-assessment SWAT teams headed by the late biologists Alwyn Gentry and Ted Parker, who visited numerous areas in numerous countries to get the broad picture of what places were most biologically diverse, INBio aims to know a few patches of forest as completely as possible.

Critics, however, say that INBio has done little more than amass a huge

# Insecta Rules the World



**T**HIS "SPECIES-SCAPE" presents an imaginary landscape where the size of organisms is proportionate to the number of species in the group it represents. The accuracy of the numbers, however, is uncertain. Many species remain undiscovered, and the evolutionary relationships among most species remain poorly understood. For example, the insect (beetle) is based on the 751,000 species known to date. Entomologists estimate the group *Insecta* may have ten million or more species. The species-scape will come into sharp focus as additional species are discovered and catalogued, providing a broad overview of biodiversity.

1	Insects ( <i>insecta</i> ) .....	751,000	11	Earthworms, etc. ( <i>annelida</i> ) .....	12,000
2	Multicellular Plants ( <i>plantae</i> ) .....	248,428	12	Birds ( <i>aves</i> ) .....	9,040
3	Mites, Spiders, Crustaceans ( <i>arthropoda</i> ) .....	123,161	13	Jellyfish, Corals, etc. ( <i>coelenterata</i> ) .....	9,000
4	Mollusks ( <i>mollusca</i> ) .....	50,000	14	Reptiles ( <i>reptilia</i> ) .....	6,300
5	Fungi .....	46,983	15	Starfish, etc. ( <i>echinodermata</i> ) .....	6,100
6	Protozoa .....	30,800	16	Sponges ( <i>porifera</i> ) .....	5,000
7	Algae .....	26,900	17	Bacteria, Blue-green Algae ( <i>monera</i> ) .....	4,760
8	Fish ( <i>pisces</i> ) .....	19,056	18	Amphibians ( <i>amphibia</i> ) .....	4,184
9	Flatworms ( <i>platyhelminthes</i> ) .....	12,200	19	Mammals ( <i>mammalia</i> ) .....	4,000
10	Roundworms ( <i>nematoda</i> ) .....	12,000			

From Q.D. Wheeler, 1990. Ann. Entomol. Am. 83:1031-1047

pile of unidentified animals and plants — a museum curator's nightmare. Others find flaws with the science underlying such burgeoning biological inventories, saying they are merely large-scale, disorganized collections run by nonexperts and doomed to fail. In Costa Rica, housewives and fishermen seek out new species, a botanist oversees the insect survey, and a virologist heads the National Biodiversity Institute — whose collections apparently contain everything but viruses.

But Dan Janzen, a visionary ecol-

ogist who has worked with the Costa Rican inventory since its inception five years ago, describes the coming changes to biodiversity studies as "a revolution," one that demands nonscientists collect species and conventional rules be set aside.

"Battle analogies aren't politically correct," Janzen says. "But we are in a war [to save species], and when you're at war you end up with doctors driving tanks."

In an assembly line set-up in INBio's offices in San Jose, workers sort through the bugs and plants, attaching bar codes to specimens like so many grocery-store items. A small team of curators strive to unambiguously identify each species, a process which can take months, even years. Sometimes they enlist an outside expert to examine, say, the long-horned beetles collected thus far.

Inventory director Jorge Jimenez acknowledges that the bulk of specimens remain unidentified. But he says it's a step in the process, and is hopeful that specialists will continue to visit to help.

Unfortunately, though, for many animals, plants, microbes, and fungi, there are no living experts who can

sit down with a crate of specimens and even begin to identify them. Groups of unknown species, called orphans by systematics practitioners, are growing in number as experts are lost through retirement and death and not replaced by their museums and universities.

### Building Hope...and a Backlash?

SPECIES IDENTIFICATION IS NOT THE ONLY problem plaguing conservation-for-profit efforts. Some economists warn that the rainforests may not produce the hoped-for profits. Saleable species may be too rare, and marketable drugs or chemicals too elusive to merit such a time-consuming, expensive search. Conservation may be profitable in theory

only; they question whether in practice it is more profitable than more immediate alternatives, such as farming or grazing the same land.

One of the few researchers who has studied the economics of conservation is Michael Norton-Griffiths, research fellow at the Harvard Institute for International Development. The problem, he explains, is that even if conservation-friendly projects like eco-tourism or sales of natural products are somewhat profitable, it is often even more profitable to use the land in more destructive ventures. The so-called "cost of lost opportunities" — the money not made by logging or farming — is borne by the local population, he observes — not by conservationists living in the Unit-

ed States. "If we're trying to sell conservation on the money that can be earned from it, we must be sure we're not selling [local] people the short end of the stick," he says.

Barbara Dugelby, a conservation biologist at Duke University, began studying extractive reserves — conserved forests from which products like chicle-tree latex, rubber, allspice, bromeliads, and rattan are harvested and sold — in the hopes that such enterprises might prevent rainforest destruction. Dr. Dugelby's up-close look at such reserves convinced her they are not the perfect solution for protecting rainforests.

Again the problem boils down to economics. All too often, Dr. Dugelby and colleagues have found, the valued

## Do Ecosystems Need Biodiversity?

**P**erhaps one of the most oft-cited arguments for preserving species is this: Biodiversity promotes and maintains the health of the world's ecosystems. While most biologists say they believe diversity is beneficial, until recently they lacked the data to support such a claim.

Now, two newly published studies test just what benefits, if any, biodiversity really holds for the world's ecosystems. Their conclusion: A larger number of species in an ecosystem can indeed have the positive effects predicted.

"The unavoidable consensus," says David Tilman, an ecologist at the University of Minnesota and co-author of one of the studies, "is that biodiversity really matters."

In a paper published in the Jan. 27, 1994 issue of *Nature*, Dr. Tilman and co-author John Downing, a statistical expert at the University of Montreal, compared 207 plots of Minnesota grassland, examining how differing levels of species-diversity affect a plot's ability to tolerate and recover from drought. They found that as the number of plant species in a plot increased, the more quickly the plot returned to its original healthy state after prolonged exposure to drought.

During the 1987 to '88 drought, the Midwest's most severe in half a century, plots with the highest plant-species richness (10 to 20 species) produced half of their average amount of plant tissue. These plots recovered fully by the following year. In contrast, low-diversity plots (one to four species) produced just one-eighth to one-sixteenth of their average productivity. It took five years for these

species-poor plots to recover fully.

What is the mechanism by which biodiversity protects productivity and stability in this ecosystem? Dr. Tilman concludes that the more species in a given area, the more likely that at least one species is resistant to natural disaster — in this case, drought. In fact, the researchers found that each additional species, up to a total of about ten, added to a plot's ability to fend off drought. Additional species beyond ten didn't appear to make much of a difference. But Dr. Tilman cautions against concluding that ten species is sufficient to protect habitat.

"Remember that this [study] has been done with respect to one single kind of perturbation," he says. "Ten species can buffer a grassland from drought, but maybe another ten are needed to protect against an outbreak of viral plant disease, and ten others from grasshopper attack. Every unusual situation carries with it unique problems."

**W**hile Dr. Tilman was charting the effects of drought in Minnesota, Shahid Naeem and colleagues at the Imperial College at Silwood Park, England, were working in the \$1.5 million ecosystem laboratory known as the Ecotron. Their work, which scientists describe as the most rigorous experimental test yet published, likewise indicates that a higher number of species makes for a more productive ecosystem.

Dr. Naeem and his colleagues created three tiny worlds — a high- (31 species), medium- (15 species), and low- (nine species) di-

species are too rare and too scattered to make hunting and gathering them a profitable venture. To support such projects the "crop" must grow in very high densities. "I don't want to build up false hopes," she says. "There may be a backlash because these extractive reserves don't work."

Even if Costa Rica's experience eventually proves that doubters are mistaken, others believe the tactic of touting biodiversity for its profits is ethically repellent. David Takacs, an environmental historian at Cornell University, says biologists typically describe their reasons for caring about biodiversity as tending toward the spiritual, not the economic.

"There is amongst conservation biologists a debate about which ratio-

nale to use to conserve biodiversity," says Dr. Takacs. "Some say whatever works is what you use.... Others say no, we have to choose our methods carefully lest we have unanticipated effects."

In the face of what scientists such as the University of Chicago's David Jablonski describe as a major mass extinction, those who would say whatever works may find ethical worries trivial. The reality is that conservation biologists of all persuasions are pressing ahead with ambitious species inventories, banking on marketing as they go. Nothing else rivals this new conservation tactic. By the decade's close, we should know whether encounters with the pharmaceutical industry will really protect the world's wild places.

The selling of conservation for profit is risky. If the tack were to fail, it could further damage the image of conservationists, who are already maligned as overly dramatic doomsayers.

For dedicated researchers, public persuasion is beside the point. Dr. Janzen, the University of Pennsylvania ecologist who has participated in the Costa Rican inventory since the beginning, reminds us that so few genes and crop plants and organisms are used in comparison with the very large quantity represented in a tropical wildland area. "It's as though we had the Library of Congress and we'd read ten books out of it. Am I raising false hopes to say, 'If you'd look at all the other stuff in the library you'd find things relevant to your lives, your industry?' I don't think so."

**versity ecosystem. Each ecosystem was replicated at least four times, with each replicate encased in a one-square meter chamber, carefully controlled and monitored. In these artificial worlds, grasses and herbs fed snails and aphids and white flies, which were in turn devoured by parasites. All the while, earthworms and spring tails helped regenerate these tiny universes, slowly aerating and feeding the soil.**

The study showed that the artificial ecosystem with the highest number of species could take up more light, consume more carbon dioxide, and create more plant biomass (growing more leaves and other plant tissues). Apparently, the high-diversity system contained a greater variety of shapes of plants, which were better able to capture every bit of light that filtered down into the chambers.

But not all of the processes monitored were affected by increased species numbers. The rate of decomposition was not measurably affected during the short, six-month experiment; neither was nutrient retention or water retention.

Dr. Naeem believes the study's take-home message is not so much that diversity is always good for ecosystem function, but that the impacts of decreased biodiversity depend on the particular species that are subtracted.

"The truth is that some monocultures are incredibly pro-

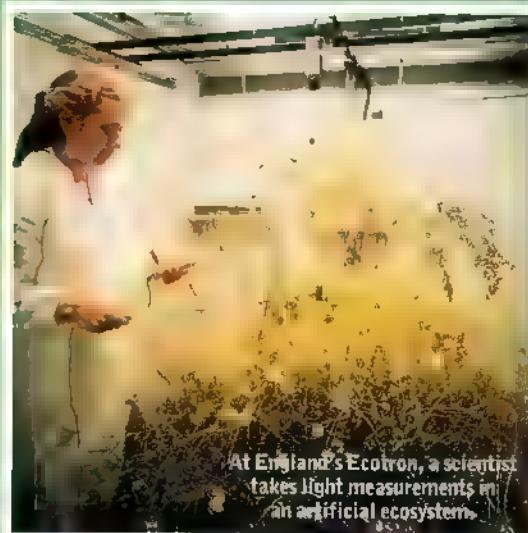
ductive," he says. "I don't know if you can beat a Nebraska cornfield on a hot, sunny day."

**B**oth Naeem and Tilman stress that biodiversity can improve ecosystem function, and that species-rich systems are well buffered against ecological disaster. They suggest that biodiversity may be most crucial as a back-up system, in case species that are performing important ecosystem functions succumb to disease or other disasters.

"Until now, discussions [about biodiversity's value] were really an arena for platitudes and arm waving" says Peter Kareiva, theoretical ecologist at the University of Washington. "In these two experiments, we find some evidence that biodiversity enhances ecosystem function. But no single experiment is in any way going to [prove biodiversity's real worth]."

In the messy field of ecology, where laws and dictums are

few and far between, ecologists must repeat such experiments under many different conditions to test whether the Tilman and Naeem studies are indeed representative of biodiversity's general effect on ecosystems. Ecologists, intrigued by the possibilities, are venturing out into fields, marshes, and forests, and again asking the same question: Does biodiversity really matter?



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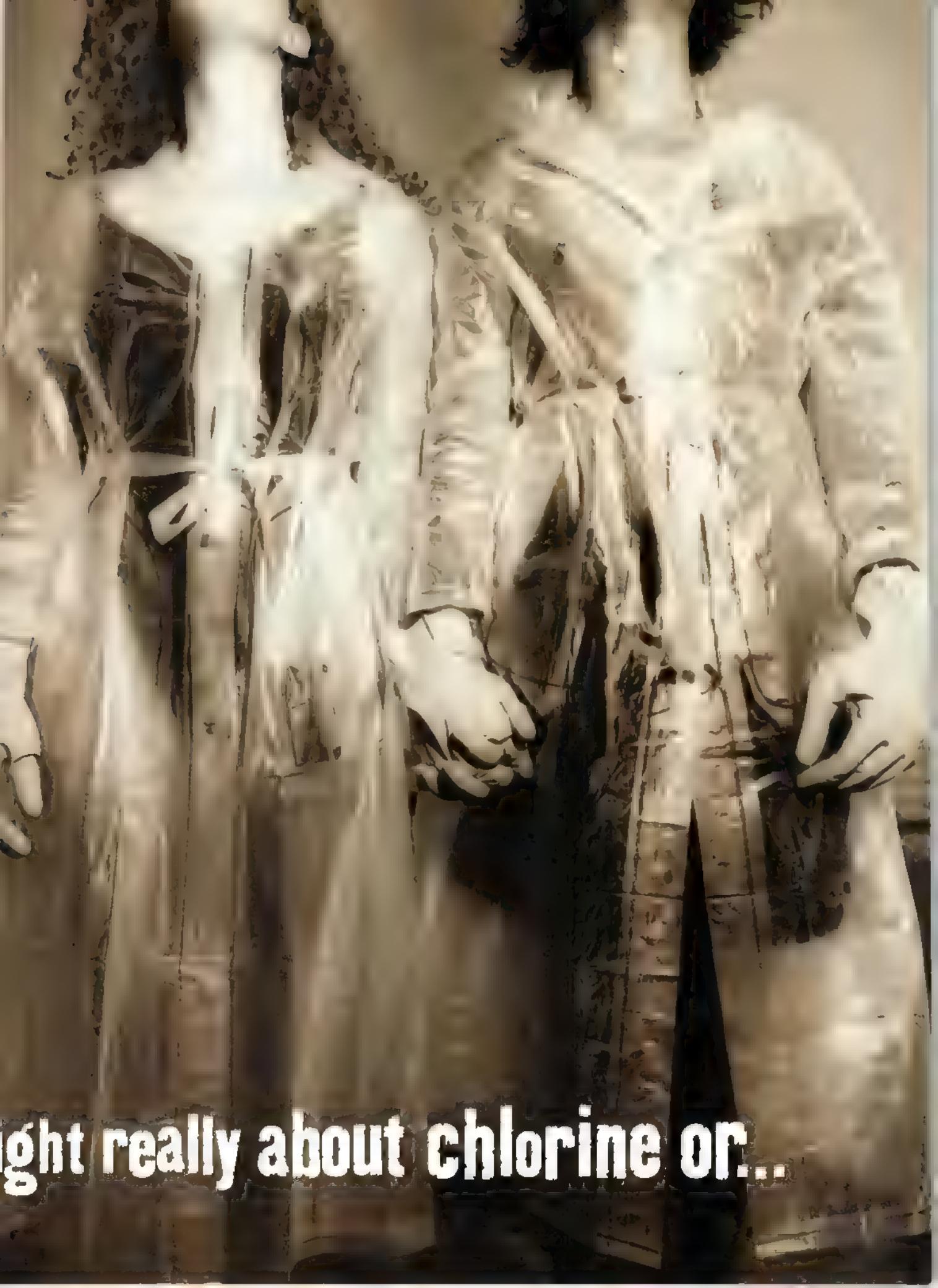
# CRUSADE TO BAN CHLORINE

By Ivan Amato

photographs by  
DEBORAH SAMUEL

# CHLORINE

Environmentalists insist chlorine must be banned from use because chlorinated compounds are potentially dangerous to health and environment. Their "precautionary principle" is seductive, but an aggressive phaseout would change thousands of industrial processes and products, disrupting technology and society. Is th



ight really about chlorine or...



# ...is it a veiled attempt to return to a pre-industrial Eden?

**O**NLY IN THE PAST YEAR OR TWO did the chemical industry realize a meteor was coming its way: a dead-serious proposal to eliminate or drastically curtail the industrial use of chlorine, skillfully brought to legislators and the public by Greenpeace and other environmentalists known for anti-technology positions. "This is the most significant threat to chemistry that has ever been posed," says Brad Lienhart, a longtime industry executive who heads the Chemical Manufacturers Association's new \$5 million campaign to counter as much of that threat as possible, for as long as possible.

At issue is the industry's previously unquestioned right to use massive amounts of chlorine, number 17 on the Periodic Table of Elements. Since the end of World War II, chlorine, a pale green gas in its elemental form, has become central to the chemical industry, and thus to thousands of processes and consumer products. "It is the single most important ingredient in modern [industrial] chemistry," says W. Joseph Stearns, director of chlorine issues for Dow Chemical Company, one of the largest producers and users of chlorine.

"It is such a valuable and useful molecule because it does so many things and is involved in so many end products," remarks John Sesody, vice president and general manager of Elf Atochem North America's basic chemical business. Chemists and chemical engineers acknowledge that chlorine is dangerous to use and handle, but argue that industry can manage these dangers well enough for society to safely enjoy chlorine's many benefits.

In fact, many in the chemical industry are passionate about the overall good they say chlorine chemistry does for society (as passionate as the anti-chlorine forces are about its potential for damage). With uses ranging from making pesticides to commodity polymers to synthesizing pharmaceuticals and disinfecting 98% of the nation's water supply, say defenders, chlorine is a substance society cannot do without.

Detractors couldn't disagree more. Polarizing the issue perfectly, "There are no uses of chlorine that we regard as safe," remarks Joe Thornton, a Greenpeace research analyst who in 1991 authored Greenpeace's case for a chlorine phaseout in a document titled "The Product is the Poison."

Among the documented "criminal actions" of some chlorine-containing chemicals: contaminating riverbeds and lush aquatic habitats such as the Great Lakes water basin; accumulating in the tissue of birds and other wildlife, where they contribute to reproductive disorders and increased incidence of disease; and causing a rare form of liver cancer in some plastics workers who were exposed to high amounts of vinyl chloride monomer (the building block of polyvinylchloride) during the 1960s, before the Occupational Safety and Health Administration imposed stringent exposure regulations.

Chlorinated organic molecules have been found in human tissues, and anti-chlorine advocates assert they may be responsible for some of the increase in breast-cancer rates over the past few decades. No one can claim a causal link between chlorine-containing chemicals and breast cancer, but the mere suggestion alarms the anti-chlorine

camp enough for them to call for its phaseout. As alternatives are available for at least some chlorine-containing products and processes, activists conclude it's better to play it safe and simply banish the element from industry. For example, activists have claimed in all sincerity, we could return to metal piping instead of PVC.

## Science isn't the name of the playing field

WHEN ASKED WHAT THEY THINK OF THE call to eliminate industrial use of chlorine, most chemists throw back a "yeah, right" look. Then they denounce it. "The idea of banning chlorine is patently ridiculous and scientifically indefensible," says Steven Safe, a Texas A&M toxicologist who for 20 years has studied such chlorinated compounds as dioxins and PCBs. Mario Molina, the atmospheric chemist now at M.I.T. who, with Sherwood Rowland, first identified the link between CFCs and ozone depletion, agrees. He told *Science* magazine last summer that banning chlorine "isn't taken seriously from a scientific point of view."

Industry may have been counting on science to throw out this challenge. Yet many participants and observers of the debate doubt that standard scientific study will play a decisive role in determining the fate of chlorine chemistry. Each side of the chlorine debate has corralled vast amounts of data (quite often the same data) to support their diametrically opposed arguments. But public perception can change much more quickly than science can unambiguously determine the real impact of chlorine on the environment and on human health.

# The Rise of Industrial Chlorine

**C**hlorine, in its form as a negatively charged ion, combines with positively charged counterparts including sodium ions to form sodium chloride, commonly known as table salt. Chloride ions populate the sea and are found in copious amounts in blood and every other tissue. Flows of chloride ions are responsible for the conduction of nerve impulses. In this sense, life just couldn't be without chlorine.

Not so for elemental chlorine. Any kind of life caught in a cloud of chlorine gas is on the fast track toward death. It reacts readily with all manner of biological tissue. (Chlorine gas was the first chemical warfare agent to be deployed during World War I.) Elemental chlorine, which consists of two chlorine atoms bound together into an electrically neutral molecule, does not normally occur naturally on Earth. Industry derives it by passing an electrical current through brine, which converts the solution's sodium and chloride ions into chlorine gas and sodium hydroxide in roughly equal proportions. Each comprises the root of an enormous industrial tree whose branches are thousands of products and hundreds of industrial processes. (See the pull-out charts on the next pages.)

What makes chlorine so industrially useful is its chemical talent for attracting electrons. It readily reacts with electron-rich atoms such as carbon, making carbon and chlorine one of the century's most versatile combinations for synthesizing molecular structures. Because their atomic combinations are so robust, many of the resulting organochlorine molecules are extremely stable, a plus for many industrial applications. But that same stability also means that once some organochlorine chemicals end up in the environment, they tend not to break down. Also, some chlorinated compounds combine persistence with a tendency to accumulate in oily locations such as fat tissue. That is what makes chlorine a villain among the environmental advocacy community.

The Georgia Gulf chlorine plant, one of many in Louisiana.



That point hit industry in the solar plexus this past February when EPA Administrator Carol Browner was quoted in the *New York Times*, the *Washington Post*, and other national media as saying that the agency's proposals for reauthorizing the Clean Water Act would include a "national strategy for substituting, reducing, or prohibiting the use of chlorine and chlorinated compounds." Ms. Browner's bombshell drew 2,000 angry letters from citizens and elected officials, and an additional 300 letters from industry, says an EPA source who asked not to be identified. "We quickly answered the ones from Congress, and now we are getting into the boxes [of letters]."

The EPA's reply, which its public-affairs office has been busy delivering to reporters, is more in line with what most scientists would suggest. The Agency's prepared statement says it "will study chlorine and chlorinated compounds to determine whether actions may be necessary to protect aquatic resources from discharges of these compounds, and it is premature to draw any conclusions about EPA's final actions before the study is completed." Even if the study becomes part of a reauthorized Clean Water Act, it is extremely unlikely that any action would be in the form of a blanket ban on chlorine, say EPA insiders.

Despite that clarification, the potential fact of industrial life without elemental chlorine, which the coverage of Ms. Browner's statements displayed in neon, puts raw fear into the heart of chlorine's defenders.

The chemical industry has never been known as a master of public relations. Greenpeace, on the other hand, the most aggressive member of the anti-chlorine consortium, could have written the book. With their "Chlorine Free" campaign, Greenpeace and allies have used every outlet to make their case.

Realizing the court of public relations will likely adjudicate the chlorine debate, the Chemical Manufacturer's Association established and bank-

rolled the Chlorine Coordinating Council (since renamed the Chlorine Chemistry Council), with Brad Lienhart as its managing director. The group hopes to counter what it views as anti-chlorine prejudice fueled more by environmentalist hysteria than hard science and sober risk assessment. Chlorine compounds, they say, ought to be regulated like other compounds — based on determinations of their individual risks and benefits, not on the mere presence of chlorine atoms in their molecular anatomies.

As its first order of business, the CCC commissioned reports on chlorine which included a massive analysis — totaling 10 volumes and 4,000 pages — of the toxicological literature on chlorinated organic compounds. The Chlorine Institute, an older industry group devoted "to the safe production, han-

That sort of lachrymose (and toxicologically meaningless) coverage just isn't available to the CCC.

### **Elemental chlorine is a cornerstone of industrial chemistry**

TO THE COMMUNITY OF MANUFACTURERS, chlorine remains a cornerstone of chemistry, playing a role in virtually every nook and cranny of modern society. By volume, chlorine is one of the largest chemical feedstocks, rivaling even petroleum. Global chlorine production now hovers around 38 million tons a year. In the United States, the number is more like 11 million tons of chlorine.

The Chlorine Institute reports that about 28% of the chlorine supply goes into making plastics, mostly polyvinylchloride (PVC), from which thousands of products are derived, among them wall coverings, floor tiles,

Just under one-fifth of the chlorine supply is consumed by chlorinated solvents such as methylene chloride, a degreaser and paint stripper, although demand for such solvents is declining as manufacturers switch to water-based and otherwise less environmentally troublesome materials and methods. Approximately 14% of the chlorine supply is used for bleaching pulp and paper; the pulp and paper industry is likewise undergoing a transition toward bleaching processes that use less chlorine or no chlorine at all. The remaining few percent of the chlorine supply goes mostly into agents for purifying drinking and waste water, and for manufacturing pharmaceuticals.

Although undisputed estimates are hard to come by, in one way or another chlorine use amounts to at least tens of billions of dollars of commerce each year in the United States alone. It employs directly or indirectly at least hundreds of thousands of people. The highest estimates, from a widely cited and much disputed economic analysis conducted for the Chlorine Institute by the Charles River Associates consulting firm in Boston, contends that chlorine accounts for \$91 billion of economic input in the U.S. and, directly and indirectly, over 1.3 million jobs.

## **The strongest argument may be that, while substitutes for chlorine and chlorinated compounds may exist in some cases, the costs to switch are prohibitive and the substitutes not necessarily any less risky.**

dling, and use of chlorine," has even prepared packaged school lessons and a video that takes students on a tour of chlorine's role in everyday products. Big chemical companies including Dow have created new full-time positions such as Director of Chlorine Issues. The aim of this emerging infrastructure, says Lienhart, is to offer the public a different view of chlorine chemistry than the one anti-chlorine forces have been purveying unchallenged for years.

Industry remains the underdog. Last October 15, the anti-chlorine lobby got the likes of Bella Abzug, the fiery former New York congresswoman and a cancer survivor, to publicly endorse a Greenpeace document linking the rise of chlorine chemistry over the past few decades to rising rates of breast cancer. The Associated Press reported the event and sent the story over the wires.

siding, pipes, shoe soles, electrical insulation, automobile components, and medical equipment. Saran Wrap is made from another major chlorine-containing polymer — polyvinylidene chloride. Just over one-third of the chlorine supply is used for synthesizing an estimated 11,000 commercial chemicals. Among the lengthy list of chlorine-dependent products are most herbicides and pesticides, dyes, chlorosilanes for making semiconductor materials, carbon tetrachloride for making nonstick cookware and refrigerants, dichlorophenyl sulfone for making computer components and power-tool housings, propylene chlorohydrin that is used first to make propylene oxide, which in turn is used to make a range of products including lubricants, coatings, brake fluids, cleaners, adhesives, pharmaceuticals, and soft-drink syrups.

### **The seeds of controversy were planted in the 1980s**

THE CONTROVERSY BEGAN WELL BEFORE Greenpeace focused its worldwide campaign on chlorine chemistry in the mid-1980s, following the lead of Germany's Green Party. Never mind the once undisputed public-health successes of chlorine use in disinfecting water, controlling insect-borne diseases, and manufacturing pharmaceuticals. Such benefits to society can easily be forgotten once the anti-chlorine alliance unleashes its ordinance.

Consider DDT, an insecticide so effective against malaria that the World Health Organization once considered shortages as threats to public health. DDT, which stands for dichlorodiphenyl-trichloro-ethane and includes five chlorine atoms in its molec-

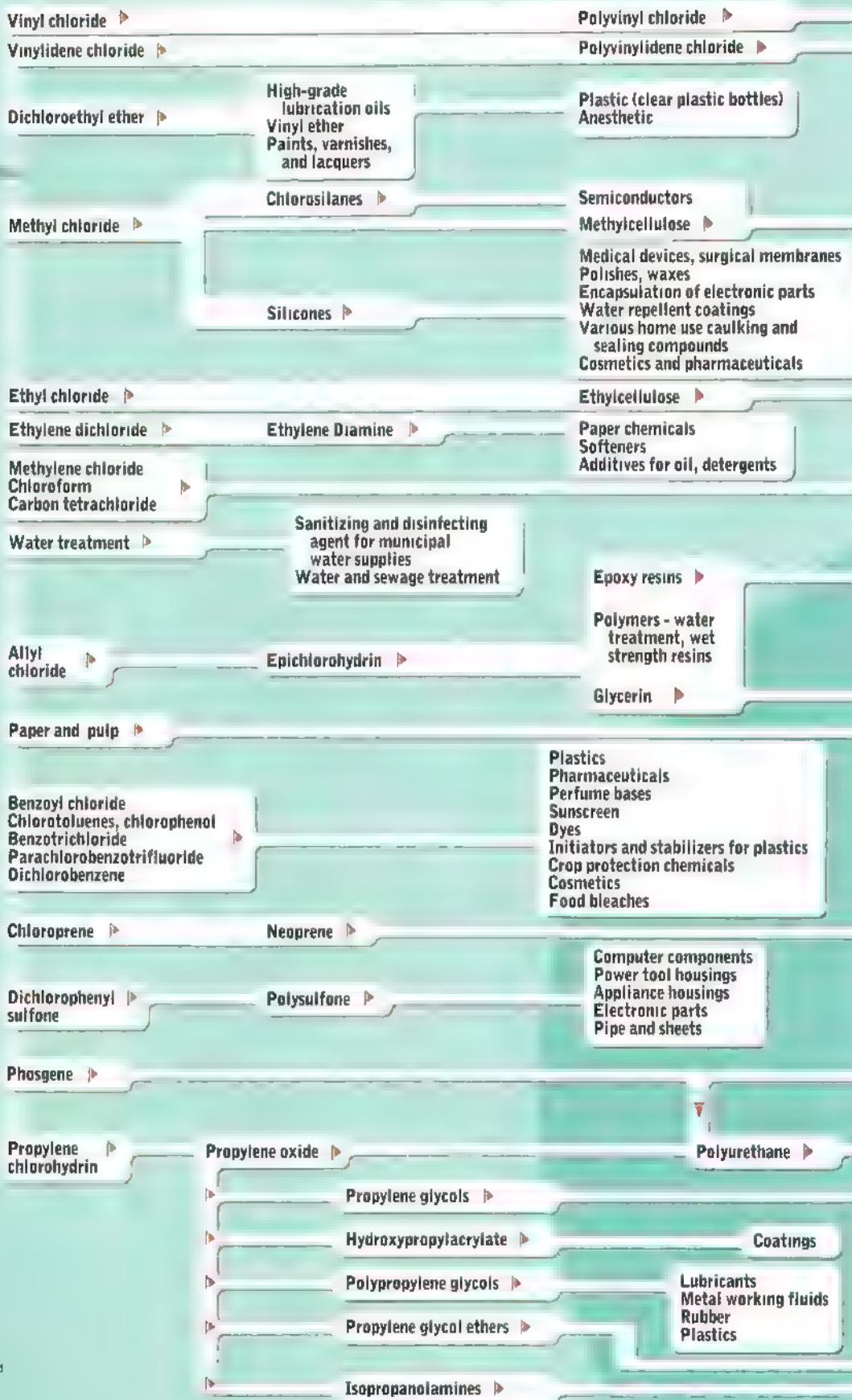
# Chlorine Chemistry and Products

## The Chlorine Tree\*

Industry makes elemental chlorine by passing an electrical current through brine, converting the solution's sodium and chloride ions into chlorine gas and sodium hydroxide (see other side).

Chlorine defenders point to the tree as an almost self-explanatory argument against any blanket ban. Anti-chlorine advocates counter that substitutes for much of chlorine's uses are available.

## CHLORINE ▶



Pipe and fittings for sewer service  
Packaging for food products, especially meats and poultry  
Multiwall bags  
Seat covers and upholstery  
Fibers and bristles  
Latex coatings

#### Thickening agent for foods and nonfoods

Time-release pharmaceuticals  
Water treatment  
Inks  
Coatings

Coatings for aluminum cans  
Surface coatings on autos, appliances, equipment  
P.C. boards, composites  
Household adhesives and glue for metals, glass, and ceramics

Pharmaceuticals  
Moisturizing compounds

Topical anesthetic  
Nonstick cookware  
Plastic processing  
Photographic chemicals  
Pharmaceuticals, cosmetics  
Paint removers, process solvents  
Dry cleaning  
Adhesives  
Corrosion resistant plastics  
Refrigerants  
Aerosols

Newspaper, copy paper, writing paper  
Coffee filters  
Tissue  
Paper towels  
Computer paper  
Printing paper (books, magazines, reports, calendars, etc.)

Oil resistant auto components  
Carpet backing and seat cushions  
Wire coating and electrical components  
Shoe soles

#### Polycarbonates

Shoe uppers and heels  
Auto bumpers and fenders  
Insulation  
Brush bristles and spandex fibers  
Adhesives  
Sealants and caulking agents  
Paints, varnishes, and coatings  
Foam cushions, mattresses

Coatings  
Paints  
Solvents  
Cleaners  
Intermediates  
Brake fluids  
Mining chemicals

Adhesives  
Coatings  
Corrosion inhibitors  
Cosmetics/personal care products  
Crop protection chemicals  
Neutralizing agents  
Plastics  
Surfactants

Luggage, handbags, and umbrellas  
Watch straps and billfolds  
Shoes and belts  
Textile fabric coatings and paper coating  
Raincoats, rainsuits, and parkas  
Magnetic recording tape  
Golf bags and recreational equipment, toys  
Exercise equipment pad coverings  
Inflatable boats and water floats  
Baby strollers, bibs, crib bumper pads, and mattress covers  
Card tables and chairs  
Woodgrain vinyl coating for stereo cabinets, radio and TV cabinets, TV carts, bookshelves, table tops, and counters  
Cases for cosmetics, cameras, binoculars, hunting rifles, and musical instruments  
Container for food products, cosmetics, toiletries, and household chemicals  
Swimming pool liners and covers  
Garden hoses and lawn furniture  
School and office supplies such as ring binder covers, pencil cases, book totes  
Floor coverings and decorative molding strips  
Wallpaper  
Siding, gutters, and gutter leaf guards  
Window and door frames  
Pipe and fittings; domestic, commercial, industrial  
Film and sheeting  
Solar reflective film  
Electrical insulation for wire and cable  
Adhesive and bonding agent base for synthetic turf  
Automobile vinyl tops, upholstery, floor mats  
Seat coverings  
Electrical and decorative vinyl tapes

Pharmaceuticals  
Crop protection chemicals  
Intermediates

Bulletproof "glass"  
Windows on buses, trains, subways, aircraft, buildings  
Household appliance housings  
Compact discs  
Protective helmets and face shields  
Containers  
Automotive and electrical components

Plastics  
Solvents  
Coatings, paint  
Food additives  
Plasticizers  
Antifreeze and coolants  
Flavoring extracts  
Soft-drink syrups  
Lotions/creams, suntan lotions  
Brake fluids  
Pharmaceuticals  
Crop protection chemicals  
Natural gas treatment

# stry and Products

Food products (especially ice cream and dietetic foods) as a water binder, thickener, suspending agent, and emulsion stabilizer  
Textile manufacturing  
Paper coatings, prints, pharmaceuticals, and cosmetics

Crop protection chemicals

Liquid soaps  
Shampoos  
Anticoagulant and used for reducing blood cholesterol  
Chelating agent

Dyeing  
Pharmaceuticals  
Rubber treatment  
Black nickel plating

Leather tanning agent  
Wallpaper printing  
Dye mordant  
Oxalic acid  
Pharmaceuticals  
Metal plating  
Catalyst

Wrapping and protective packaging

Cements  
Textiles  
Adhesives  
Cosmetics  
Pharmaceutical lotions and jellies  
Asphalt emulsions

Latex paints

Soaps  
Grease  
Pharmaceuticals  
Gelling agent  
Plastics stabilizer  
Cosmetics

Automotive and electrical components  
Coatings and sealants  
Adhesives  
Insulation  
Foamed products

Wearing apparel  
Surgical dressing  
Nonwoven fabrics  
Coated fabrics  
Felts and blankets  
Blends for home furnishings

**Sodium hydroxide,**

**chlorine's fraternal twin,**  
**plays a central role in**  
**the production of chlorine.**

**No one, however, is**  
**calling for a ban of**  
**sodium hydroxide.**

Automotive radiator cleaner  
Leather tanning  
Textile bleaching  
Rare earth processing  
Purifying agent and intermediate

Lacquers  
Ink  
Adhesives  
Pharmaceutical binder, filler, and protective tablet coating  
Gel lacquers

Coating and glaze for food items  
Ink  
Pharmaceuticals

Pharmaceuticals  
Dyeing, textiles  
Silicate, catalyst, builders  
Oleate, emulsifier  
Acid gas solvent  
Specialty glasses (TV tubes)  
Bicarbonate - food, medicinals  
Sulfite - printing, dyeing, disinfectant, preservative

POTASSIUM HYDROXIDE  
(Caustic potash, KOH)

Potassium carbonate

Potassium phosphates

Other salts

Fertilizers  
Liquid soaps  
Textiles  
Greases  
Catalysts  
Batteries

Food preservatives  
Pharmaceuticals  
Photographic chemicals, dryers  
Ceramics  
Soaps and detergents  
Emulsifiers  
Catalysts



# Sodium and Potassium Hydroxide Chemi

## The Sodium Hydroxide Tree

When salt water is electrolyzed, two molecules of sodium hydroxide form for every molecule of elemental chlorine. Likewise, for every chlorine molecule produced during electrolysis of potassium chloride, two molecules of potassium hydroxide are produced (lower right). Compounds on the far right are the products of a reaction between sodium hydroxide and another precursor. (In each case, the precursor is different.)

**SODIUM HYDROXIDE**  
(Caustic Soda, NaOH)

Refining vegetable oils  
Rubber reclamation agent  
Metal processing  
Ore flotation  
Metal degreasing  
Aluminum ore (bauxite) purification  
Disinfectant  
Alkaline bottle washing formula  
Latex rubber stabilizers

Food additive

Fruit and vegetable peeling

**Sodium chemicals**

Etching

Electroplating

Wood pulp (soda process)

Wallboard

Groundwood pulp bleaching

Refining of Kraft (chemical cellulose)

Petroleum refining (sweetening)

Gas scrubbing  
Water treatment, pH control

Ion exchange regeneration

Xylenesulfonec acid

Sodium stearate

Sodium lauryl sulfate

Sodium naphthenate

Sodium oleate

Textile processing  
Creeping agent for textiles  
Mercerizing cotton  
Scouring cotton  
Vat dyeing

Epoxies

Polyurethanes

Polycarbonate

Sodium chloroacetate

Sodium carboxymethylcellulose  
Dyes  
Vitamins

2, 4-Dichlorophenoxyacetic acid

Case hardening and heat treating agent for steel

Ethylenediaminetetra acetic acid

Ore flotation

Dyes

Pharmaceuticals

Plastics

Sodium thiocyanate

Extraction agent for gold and silver production from ores  
Electroplating agent for copper, zinc, brass, and cadmium

Sodium formate

Sodium chlorite

Bleach for textiles, paper pulp, edible oils, and straw products  
Oxidizing agent for dyes

Rayon

Cellophane

Ethylcellulose

Hydroxyethyl cellulose

2-Hydroxypropyl cellulose  
2-Hydroxyethyl methyl cellulose

Cellulose xanthate

Alkali cellulose

Dyes  
Synthetic detergents  
Catalyst

Aluminum stearate  
Calcium stearate  
Zinc stearate

Wetting agent for textiles  
Surface active agents  
Detergents

Ore flotation  
Waterproofing textiles  
Emulsifier  
Soaps

Adhesives  
Coatings  
Electrical compounds

Bulletproof "glass," windows  
Appliance housings  
Containers  
Automotive and electrical components  
Compact discs

Surface-active agents  
Emulsifier  
Disinfectant  
Driers  
Fuel additive

## Hydrochloric acid ▶

- Food processing ▶
- Desulfurization agent for petroleum
- Production of alkyl chlorides ▶
- Oil well acidizing
- Production of metallic chlorides ▶
- Pickling in steel manufacture
- Water treatment
- Production of hydrochlorides ▶
- Latex coagulating agent

Sugar refining  
Corn syrup  
Gelatin  
Monosodium glutamate  
Brewing

Electronic silicone  
Catalysts  
Photoflash bulbs  
Refractories  
Alloys  
Pyrotechnics

Rubber accelerator  
Plastics stabilizer  
Rocket propellants  
Pharmaceuticals

Polymers, ion exchange resins  
Permanent wave solutions, hair care products  
Crop protection chemicals  
Synthetic caffeine, vitamins  
Vinyl stabilizer  
Pharmaceuticals  
Thickeners, food additives

## Flame retardants

- Cable insulation
- Highway stripe paint
- High-pressure lubricants
- Flame retardants
- Plasticizers for polyvinyl chloride
- Detergents

- Gasoline additives, hydraulic fluids
- Intermediates
- Semiconductor manufacture
- Fire-retarding agents
- Crop protection chemicals

Photographic chemicals, dyes  
Intermediates  
Rubber antioxidants  
Purifying sugar juices  
Band-aids  
Erasers  
Oil additives  
Pacemaker batteries  
Crop protection chemicals

Photography, etching and engraving  
Water treatment  
Printed circuitry  
Pharmaceuticals

Soldering fluxes  
Deodorant preparations  
Dental cements and dentifrices

Bleaching pulp, paper, and textiles  
Water purification  
Pharmaceuticals  
Household bleach  
Disinfectant for swimming pools

Paper de-inker  
Transformer fluid  
Circuit boards  
Drain cleaners  
Textile manufacture  
Leather finishing  
Pigments  
Dyes  
Refrigerants  
Spot remover  
Crop protection chemicals  
Solvents  
Adhesives  
Degreaser  
Dry cleaning agents

Electrical components  
Semiconductors  
Corrosion-resistant paint  
Synthetic gemstones  
Catalyst  
Paint pigment, opacifiers  
Titanium metal

## Methyl chloroacetate ▶

## Chloroacetic acid ▶

Liniments  
Pharmaceuticals

## Tetrachlorophthalic anhydride ▶

- Cable insulation
- Highway stripe paint
- High-pressure lubricants
- Flame retardants
- Plasticizers for polyvinyl chloride
- Detergents

## Chlorinated olefins and paraffins ▶

## Sulfur dichloride Sulfur monochloride Thionyl chloride Sulfuryl chloride

## Phosphorus trichloride Phosphorus pentachloride Phosphorus oxychloride

## Ferric chloride ▶

## Stannous chloride ▶

## Zinc chloride ▶

## Other metal chlorides ▶

## Chlorinated isocyanurates ▶

## Sodium hypochlorite ▶

## Calcium hypochlorite ▶

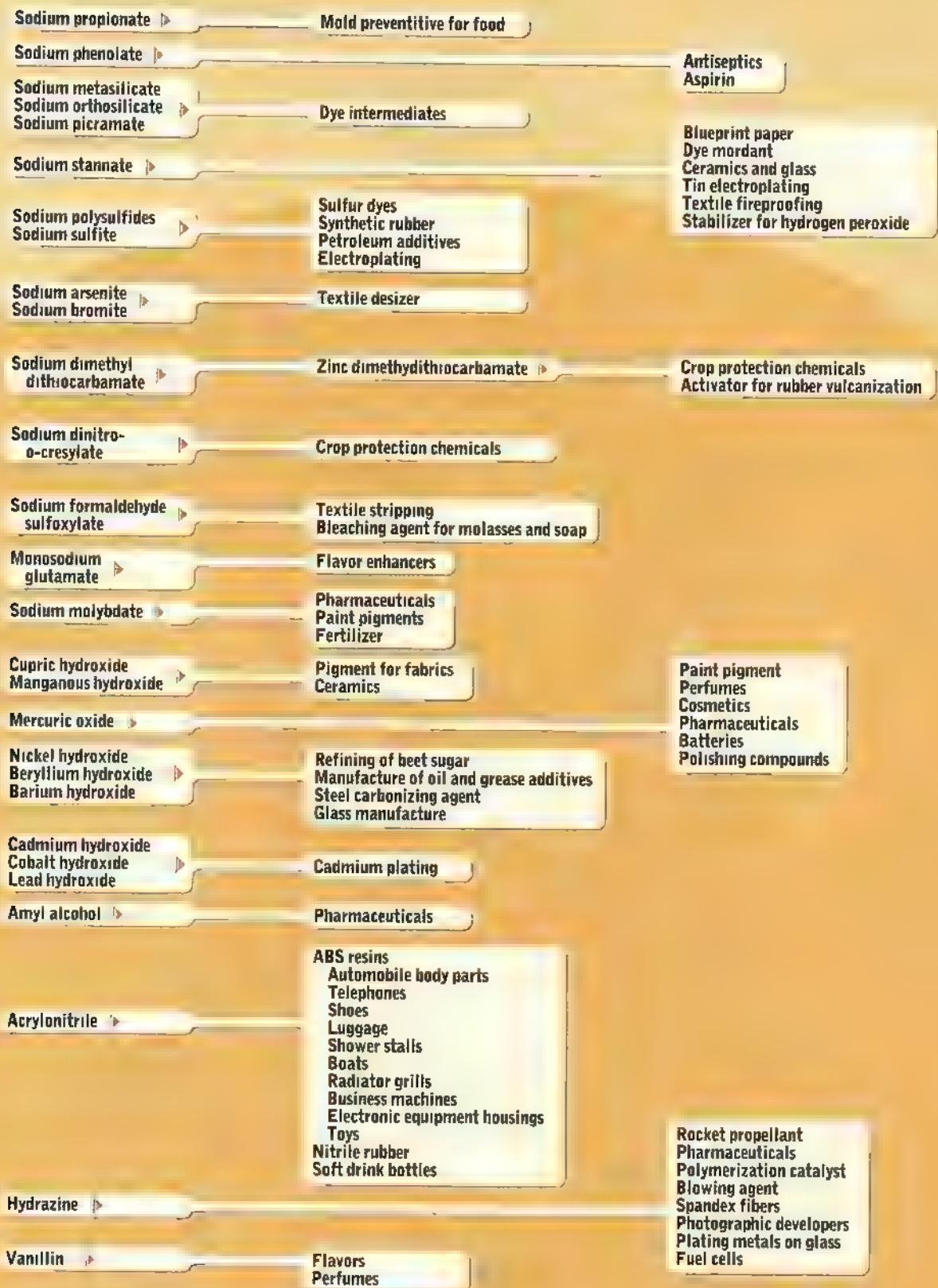
## 1, 1, 1 Trichloroethane Perchloroethylene Methylene chloride Trichloroethylene

## Titanium dioxide ▶

- Algaecide, bactericide
- Deodorant
- Potable water purification
- Disinfectant for swimming pools

Transformer fluid  
Circuit boards  
Drain cleaners  
Textile manufacture  
Leather finishing  
Pigments  
Dyes  
Refrigerants  
Spot remover  
Crop protection chemicals  
Solvents  
Adhesives  
Degreaser  
Dry cleaning agents

Electrical components  
Semiconductors  
Corrosion-resistant paint  
Synthetic gemstones  
Catalyst  
Paint pigment, opacifiers  
Titanium metal



ular structure, became the rallying point of the then-nascent environmental movement when Rachel Carson documented its unanticipated effects on the environment and wildlife in her 1962 book *Silent Spring*. (Although DDT has never been proved to be a significant human hazard, it was banned from use in the U.S. because it was known to bioaccumulate or be deposited in body fat at relatively low levels of exposure.)

Add the notoriety of chlorovillain PCBs, or polychlorinated biphenyls, a family of about 180 compounds that have anywhere from two to ten chlorine atoms in their molecular anatomies. PCBs' stability, low flammability, and insulating properties made them favorites for electrical and hydraulic equipment, but those same properties (along with their solubility in fat) likewise enabled them to accumulate to levels of concern in the cells and fat tissue of animals and people.

DDT and PCBs are not the only so-called organochlorine compounds that have a place among chemicals *non grata*. Even inorganic chlorine compounds that do not themselves persist in the environment, and presumably pose little long-term risk on their own, can break down into harmful molecules that do stick around. When the elemental chlorine used to bleach paper and the volatile chemicals used to make PVC plastic break down in the environment, they can spawn polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). Both are suspected human carcinogens and both have documented adverse affects on wildlife in the Great Lakes region and elsewhere.

PCPs, or chlorofluorocarbons, whose

nontoxicity, low cost, and physical and chemical properties had for decades made them just about perfect for large-scale cleaning and refrigeration uses, have become perhaps the best known and most vilified chlorinated compounds of all. PCPs' probable ozone-depleting properties, which never occurred to their originators in the 1930s, now overshadow all that's good about

**"There are no uses of chlorine that we regard as safe," remarks Joe Thornton, a Greenpeace research analyst who in 1991 authored Greenpeace's case for a chlorine phaseout.**



them. By the end of 1995, industry will halt the manufacture of PCPs in accordance with the international Montreal Protocol, a global response that anti-chlorine advocates view as an important precedent for their more ambitious goal of banning the industrial use of chlorine entirely.

The above noted "chemical black list" represents a tiny fraction of the chlorinated compounds in use. Even so, activists in Germany's Green Party and then at Greenpeace began, as Brad Lienhart puts it, "connecting the dots" between those few notorious chlorovillains and all chlorine-con-

taining compounds. Even though the majority of chlorinated compounds have never been studied for their toxicological effects, Greenpeace views them as a single class of chemicals that should be considered unfit for commercial use until proven safe — a virtual impossibility, both scientifically and economically.

If Greenpeace were alone in its fight against chlorine, the Dows, Monsantos, and Du Ponts of the world might not have much to worry about. But the chemical industry decided that the call for a ban was more than environmentalist bravado when a normally conservative United States/Canadian commission, the International Joint Commission, officially announced comprehensive anti-chlorine recommendations to their respective governments in their biannual report of 1992.

The IJC's scientific panels and advisors convinced its six commissioners that chlorinated compounds are persistent enough in the Great Lakes region that a recommendation to phase them out is prudent. Although the Commission concedes that many of the synthetic chlorinated organic substances identified in the water, sediment, and biota of the region have not been identified as individually toxic, it concludes that many of these chemicals — because of their shared chemical characteristics — will be identified as persistent toxicants.

The IJC recommended in 1992 that the U.S. and Canada "develop timetables to sunset [phase out] the use of chlorine and chlorine-containing compounds as industrial feedstocks, and the means of reducing or eliminating other uses [such as water treatment and paper bleaching] be examined." Moreover, other "treaty" organizations

that oversee the use of international waters have articulated similar anti-chlorine positions.

"The IJC lit up our lives," says Rick Hinds, legislative director of Greenpeace's toxics campaign.

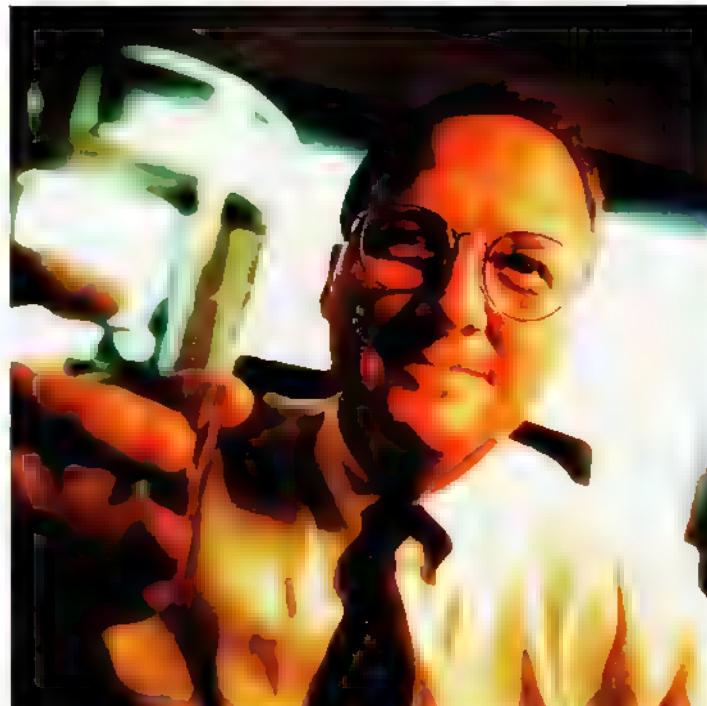
Despite rigorous lobbying by the CCC to stop lumping the entire menagerie of chlorine-containing compounds into one huge regulatory class, the IJC is standing firm. Its 1994 biannual report, issued following its most recent gathering in Windsor, Ontario, redoubled calls for sunsetting chlorine. Brad Lienhart, who participated in the IJC meeting, thinks that some gains were made despite the anti-chlorine message. The IJC's Virtual Elimination Task Force, which develops strategies to eventually eliminate all toxic inputs to the Great Lakes, agreed there is a need for "a thorough and complete analysis of chlorine chemistry before any schedule for sunsetting chlorine is implemented," Mr. Lienhart says. He believes such an analysis will vindicate much of chlorine chemistry as a sensible, environmentally responsible choice for manufacturers.

Following that mild concession by the IJC, though, another voice joined the anti-chlorine chorus. In early November, the American Public Health Association, which represents 50,000 public-health workers, registered some of the strongest anti-chlorine positions yet heard. A final draft of the APHA's position states "the only feasible and prudent approach to eliminating the release and discharge of chlorinated organic chemicals and consequent exposure is to avoid the use of chlorine and its compounds in manufacturing processes." The resolution concedes that not all uses of chlorine, especially such

public-health uses as disinfecting drinking water and pharmaceutical production, have feasible alternatives — thereby implying that those uses of chlorine ought to be continued. But APHA calls for provisions to retrain workers displaced from a shrinking chlorine industry.

### **The cases for & against may rest on risk or benefit to society**

LIKE LOOKING AT CLOUDS, BOTH SIDES CAN see what they want in existing data, or commission hand-picked scientists to do studies that lend credence to their respective interpretations.



**Industry insider Brad Lienhart tirelessly points out that the many thousands of organochlorine compounds in use are chemically, physically, and biologically heterogeneous.**

In lieu of objective scientific debate, methodological and philosophical issues are at the fore. One of the largest gulfs between the two camps centers on the unprecedented call to consider all chlorinated compounds in use as a single class subject to regulatory action. The case for banning all industrial uses of chlorine is easier to explain, which

gives it a decided advantage over the more complicated argument of chlorine's defenders. The basic argument starts with reference to DDT, PCBs, dioxins, PCPs and a few other compounds that have documented effects. Next the argument points out that all of these compounds have one thing in common, namely, the presence of chlorine atoms in their molecular structures.

Finally, the argument takes an inferential step — and this is the precise point of contention. It concludes that, because of this commonality, all other chlorine compounds are suspected environmental and biological hazards.

The concept of "reverse onus" would be applied to all chlorinated compounds: an assumption that they produce toxicity unless otherwise proved by the seller. Since chlorine detractors admit that most chlorine dependent compounds have never been shown to have hazardous effects and have never even been studied, they refer to this conclusion as "the precautionary principle."

Another key component of the argument points to correlations between the presence of chlorinated organics in sediments, water basins, and tissues of animals and humans, on the one hand, and, on the other, incidences of wildlife population declines, reproductive and developmental anomalies in animals and people, and various dis-

eases, including cancer. Theo Colborn, a Fellow at the World Wildlife Fund who chaired an often-cited gathering of toxicologists, ecologists, immunologists, and other scientists three years ago, said in an interview that "we have reached a point [of loading toxic synthetic chemicals in the environment and living tissue] that we ought to be con-

cerned about releasing more."

The so-called "precautionary principle" is seductively simple. There are simply too many chlorinated compounds to study on a one-by-one basis to assess their safety. "There aren't enough rats in the world to assess individual compounds and what their combined effects might be," says Tufts University biologist Ana Soto, who is studying how compounds including PCBs can mimic the hormonal effects of estrogen.

Nevertheless, the pro-chlorine advocates assert that the only scientifically defensible way to ascertain chlorine's health and environmental effects is to do toxicological, epidemiological, and other studies of specific organochlorine chemicals. They point out that the scientific data simply does not exist to implicate any but a very few organochlorine compounds, such as DDT and PCBs

— which have been studied for many years. Brad Lienhart tirelessly points out that the many thousands of organochlorine compounds in use cannot legitimately be thought of as a single class because they are chemically, physically, and biologically heterogeneous. Adds W. Joseph Stearns, Dow's director of chlorine issues: "The substantive part of this issue is that some organochlorines are persistent toxics, not that all organochlorines contain chlorine."

Indeed, many organochlorine compounds have short lifespans in the natural world. Mr. Stearns argues that to condemn any compound because it contains chlorine in its molecular structure will lead to a whole host of environmental regulations that the actual risks do not call for. And depriving society of thousands of useful, chlorine-based products without ascertaining if the risks are unacceptable, says the pro-chlorine camp, is a misguided formula that will greatly damage the nation's economic strength and standard of living.

### Greenpeace's insistence that "substitutes exist" is misleading

CHLORINE'S DEFENDERS CAN POINT OUT the importance of its use in modern industrial chemistry, and try to explain the complex toxicological reasons why tens of thousands of compounds having

necessarily any less risky.

Susan Sieber, a toxicologist and Deputy Director of the Division of Cancer Etiology at the National Cancer Institute, warns that hasty blanket bans can have the unwanted effect of pushing alternatives that are worse. "You need to assess the risks and benefits," she says.

Attempts at sober assessment that would fall between the two camps have begun in earnest. One example is a 180-page report that the M.I.T. Program in Technology, Business and Environment prepared for the Norwegian government and European industry groups. The report begins the daunting task of assessing the economic, social, and environmental costs and gains of non-chlorine substitutes, focusing on several areas including cleaning solvents in the electronics industry, polyvinylchloride (PVC) plastic, chlorinated pesticides, and chlorine-based bleaching agents.

The report notes that a trend toward chlorine-free bleaching technologies in the paper industry shows that major categories of chlorine use are not absolutely necessary for the industries that have been heavy chlorine users. "This suggests that concerns over the unavailability of such alternatives in other cases of chlorine use may be overblown," concludes the summary of the report's findings.

Availability of substitutes, however, is only part of the story. Among the big caveats:

- ◆ Substitutes carry their own environmental and health effects. For example, water-based substitutes for PCBs in the electronics industry add a new source of water pollution. The return of hydrocarbon coolants and insulating fluids for electrical transformers has brought back the fire hazards that PCBs had virtually eliminated.

- ◆ Chlorine-based technologies themselves may have been less hazardous replacements for nastier technologies. A

#### LETTER TO THE EDITOR

### Natural Source of Organochlorides

**I**MMENSE QUANTITIES OF ORGANOCHELORINES and other organohalogen chemicals occur naturally in our biosphere — nearly 2,000 different compounds at last count, 700 of which were discovered in the last 10 years alone — with new examples being isolated and identified regularly ("Organochlorines lace Inuit breast milk," SN: 2/12/94, p. 111).

For example, nearly 100 different natural halogen compounds are present in one species of edible Hawaiian seaweed, and one species of Florida Gulf acorn worm produces 20 different organohalogen compounds. Some 5 million tons of natural methyl chloride are produced by the biomass annually, dwarfing the 26,000 tons of emissions produced by humans. Tetrachloroethylene, chloroform, carbon tetrachloride, methylene chloride, and several natural PCBs have been detected in the emissions of the Santiaguito volcano of Guatemala and the Kamchatka volcanoes of Siberia. Previously unknown PCB isomers were discovered in Mount St. Helens' volcanic ash.

Obviously, not all of these halogen sources add significantly to the total halogen content of the biosphere, but many do. In any event, chlorine is as natural to our world as carbon, oxygen, and hydrogen.

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nothing in common but chlorine should not be treated as a single class of chemicals. But their strongest argument may be that, while substitutes for chlorine and chlorinated compounds may exist in many cases, the costs to switch are prohibitive and the substitutes not

chlorine-dependent route to titanium dioxide, a widely used pigment in white paint, replaced the dangerous lead-based pigments that contributed to a public-health calamity. The chlorine-dependent process produces one-sixth the hazardous waste of an alternative process that relies on sulfuric acid.

♦ Affordable alternatives that can perform as well as the chlorine-dependent product may not exist. In these cases, technological innovation and development can take a long time, at great cost. The report cites the absence of any drop-in replacements for PVC that automakers could use for air conditioning systems of cars after the PVC ban goes into effect.

### **Now see the whole picture, but legislators and user groups have begun to react**

GREENPEACE BELIEVES IT HAS INDUSTRY on the run. "The writing is on the wall," says Jay Palter, Toronto director of the group's Chlorine Free campaign. "A chlorine phase-out is inevitable and industry is just stalling for time."

Industry representatives don't see it that way. "Greenpeace is not fundamentally changing the way we do business," says Michael W. Berezo, director of environmental strategy for Monsanto. At the moment, neither EPA nor its Canadian counterpart, Environment Canada, has accepted the notion that all chlorine compounds ought to be regulated or phased out as a class. Berezo does concede that the ascent of the chlorine issue is pushing Monsanto and other companies to look more aggressively at alternatives to chlorine-containing chemicals. But industry's dilemmas lack easy answers.

Specific user groups have begun to wrestle with the chlorine issue as it affects them. The Jan/Feb '94 issue of the newsletter *Environment Building News* ran a 10-page article titled "Should We Phase Out PVC?" The report makes a Herculean effort to integrate the available information on PVC's

benefits and the dangers stemming from its manufacture into a picture that might guide its readers. After concluding that its account left more questions than answers, the article counseled the 1,200 builders and architects who subscribe to the newsletter to "seek out better, safer, and more environmentally responsible alternatives" to polyvinylchloride — without actually suggesting that readers completely avoid vinyl materials. PVC accounts for more than a quarter of worldwide chlorine use, so such recommendations can have far-reaching effects.

Perhaps the most newsworthy

reaction. (The requirement didn't make it into the final order.)

Even a year ago, engineering professor David Marks, who is coordinating M.I.T.'s \$1.8 million cross-disciplinary study of chlorine, thought the anti-chlorine movement couldn't box its way out of an unbleached paper bag. Now he wonders. "The chlorine industry could wake up one day and see many anti-chlorine bills on the table in Congress," he warns. "Things are moving so fast, it's hard to tell how it will end up."

Industry is well aware how quickly a few Bella Abzugs can alter public perception. Despite the difficulties in switching to chlorine-free production, progressive companies are eyeing such strategies as pollution prevention and substitution to preempt future, more costly adjustments. Truly farsighted companies aim to turn anti-chlorine sentiment into a market. Dow has created a new business entity called Advanced Cleaning Systems, which provides water-based cleaning technology and support services for green industrial niches. And Louisiana Pacific, one of the country's largest paper manufacturers, is trumpeting its new chlorine-free bleaching process at a plant in Samoa, California.

Should there be a chlorine phaseout, it would probably occur in a piecemeal fashion, hopping from product category to product category. Both sides will continue to debate the data on what effects chlorinated compounds have on the environment and human health. But it seems quite possible that even without government-imposed limits, public perception and the market forces that follow from it will dictate the future of chlorine's role in industry and society.

#### LETTER TO THE EDITOR

### **Let's Ban Oxygen, Too**

I READ THAT GREENPEACE AND OTHER ENVIRONMENTAL organizations propose the banning of all compounds that contain the element chlorine. In the same spirit, I believe all compounds containing the element oxygen should also be banned, because such well-known components of smog as ozone, carbon monoxide, and nitrogen oxides all contain oxygen. I am starting a new grassroots campaign to support this worthy cause. It will be called No Oxygen (NO), and our slogan will be "Just Say NO."

— T.S. Benedict Yen, Dept. of Pathology  
Univ. of California, San Francisco

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feature of the chlorine controversy is that it has progressed to the point where a ban is being taken seriously by governments and industry. And even if the meteor of a ban is deflected by pragmatic concerns, chlorine chemistry may be forever changed by an asteroid shower of legislation. In October, Rep. Bill Richardson (D-NM) delighted environmentalists by reintroducing a bill that would legislate chlorine out of the pulp and paper industry within five years. In October, the Clinton administration nearly issued an executive order that would have mandated government to buy paper made without chlo-

The editors wish to thank Dr. Steven Sase of Texas A&M University, and organic chemist Dr. Albert Dittman, for providing technical review of this article.

# udder angst



**The controversy over synthetic bovine growth hormone is much more than a dispute over health effects in cows and humans. It's the opening battle in a high-stakes war over the future of biotechnology. By Dan Kennedy  
Photographs by The Douglas Brothers**



TO JUDGE FROM THE OPPosition's RHETORIC, you'd think recombinant bovine growth hormone (rBGH) involved a plot to feed toxic waste to cows, store their milk in nuclear reactors, and then distribute it to kindergartens and day-care centers.

The Pure Food Campaign, headed by Jeremy Rifkin, calls rBGH the first in a series of "genetically engineered Frankenfoods . . . where the blueprint for life is changed without democratic control." Texas populist Jim Hightower accuses the federal Food and Drug Administration of "forcing our children to be Monsanto's guinea pigs," a reference to the St. Louis-based company that developed and manufactures rBGH. Facing threatened boycotts, retailers have pledged not to sell any dairy products from farms that use it.

The synthetic hormone rBGH is an exact replica of natural BGH, which controls a cow's lactation; regular injections of rBGH are said to increase milk output by 10 to 20%. Despite extensive testing over the past decade, questions

remain about its effects on both human and animal health which — given the competing scientific claims — the average consumer can't hope to sort out.

Nor can shoppers easily avoid dairy products made from milk produced by rBGH-treated cows. Although there's a growing movement to label milk that does not come from treated cows, the FDA has set voluntary guidelines for such labels, discouraging claims that milk from untreated cows is more healthful. While the guidelines do not have the force of law, Monsanto has sent threatening letters to dairy companies warning that labeling is false unless it complies with the FDA's suggested wording. (See "Labels Launch Lawsuits," p. 45.) What's more, it's almost impossible to stay entirely away from rBGH. Even a humble staple like Kraft macaroni and cheese may contain milk from treated cows, as Kraft does not require its suppliers to certify their milk as being rBGH-free.

Opponents, though, have spark-

ed an outcry that's wildly out of proportion to the mild concerns they've raised. Their motivation is hardly scientific. It's more a philosophical bias against any form of genetic engineering — or, for that matter, against the very notion of technological change.

"There's a fairly significant and vocal segment of the body politic that would like to see us forgo technology and, I personally think, revert back to the way we used to do things 50 or 100 years ago," says John Urbanchuk, a dairy economist with AUS Consultants, based in the Philadelphia area, who believes rBGH is safe and supports its use.

### Possible Benefits

MR. RIFKIN AND HIS FOLLOWERS' IDEOLOGICALLY based opposition has led them to ignore possible environmental benefits. Because rBGH would reduce the number of cows needed to produce a given quantity of milk, the federal Office of Management and Budget has concluded that its use would have a small but positive





**pponents have sparked an outcry that's wildly out of proportion to the somewhat mild concerns they've raised. Their motivation is hardly scientific. It's more a philosophical bias against any form of genetic engineering — or, for that matter, against the very notion of technological change.**

impact: less grain would be needed for feed, less animal waste would be produced, and less land would be damaged by grazing herds.

"If all the milk in the United States came from cows treated with rBGH [bovine somatotropin, another term for the dairy hormone], we could cut animal waste by literally billions of pounds," says Dale Bauman, a Cornell University professor of animal science who was among the first to study how a cow's rBGH levels affect milk production, and who's consulted for Monsanto.

Opponents claim that rBGH would instead harm the environment, because it would encourage intensive factory-farming practices that cause soil and water pollution. In fact, although the hormone is as available to small family farmers as it is to large corporations, there is some evidence that rBGH would accelerate the trend toward larger dairy operations, since its successful application requires more closely controlled herd-management techniques.

Consumers Union, publisher of *Consumer Reports* and a staunch opponent of rBGH, argues its use "will result in increased pollution of surface and groundwater from urine and manure generated on large-scale confinement feedlots." In addition, Consumers Union warns, waste water from rBGH manufacturing facilities

could seep into aquifers, carrying genetically engineered, rBGH-producing bacteria into water supplies.

Another oft-raised concern is that because rBGH would increase dairy production, it would add to the nation's milk surplus and drive up federal subsidies. This may well be true, but only because of dairy farming's irrational economics.

Each year, the federal government spends more than a half-billion dollars to prop up dairy prices so that farmers can earn a fair return. These subsidies encourage farmers to produce more milk than the market can handle. The result is an inefficient system whereby marginal farmers who should go out of business hang on, scratching out a living because of taxpayer subsidies.

Ironically, rising efficiency has already taken a toll on the family farms that subsidies are supposed to help. An article by Jonathan Rauch in the *National Journal* reports that milk production per cow rose by about 2.5% a year between the mid-1950s and 1990. During that same period, the number of commercial dairy farms declined from 600,000 to 160,000.<sup>1</sup> The use of rBGH would accelerate that trend by making dairy farms even more efficient — a boon in a true market economy. Because of subsidies, though, consumers would not benefit from the full effect of

that increased efficiency: prices would remain artificially high; tax money would keep some, but not all, marginal farms alive; and the dairy surplus, though not as big as it was in the 1980s (when news reports featured mountains of stockpiled cheese and butter) would remain a persistent problem.

The system that rBGH threatens is responsible for real damage to the nation's most vulnerable people. In 1988 two agricultural economists, Dale Heien and Cathy Roheim Wessells, reported in the *Journal of Consumer Affairs* that dairy subsidies, by keeping prices high, had a measurable statistical effect on the ability of poor people to meet their nutritional needs. Their conclusion: "Nutrient intake would be increased substantially, especially for calcium" if subsidies were eliminated.<sup>2</sup> In a true market economy — one without subsidies — rBGH would drive prices down still further by making milk production more efficient.

### **Is it Safe?**

THE FDA APPROVED rBGH THIS PAST November because the agency determined, after a "thorough review," that the synthetic hormone is safe for dairy cows; that milk from rBGH-treated cows is safe for human consumption; and that production and use of the product do

not have a significant impact on the environment. The FDA declined to require special labeling for milk from rBGH-treated cows, in large part because its staff believes the agency lacks authority to do so. Their reasoning: Milk produced by cows injected with rBGH cannot be distinguished from the milk produced by untreated cows. Because the agency's jurisdiction is limited to substances consumed by humans, and the dairy hormone does not directly affect human health (only, perhaps, the health of cows), the FDA opted to leave it to individual states to ensure that labeling claims are truthful — since milk production has traditionally been overseen at the state level.

The dairy hormone went on sale in February, following a three-month moratorium imposed by Congress. Currently, about 10% of dairy farmers are using rBGH. Even though a number of respected groups, including the American Medical Association and the World Health Organization, have deemed milk from treated cows is safe, questions continue to be raised. Essentially, there are three health-related issues.

First, opponents say a cow injected with rBGH is more likely to contract the udder infection mastitis, and that the antibiotics used to treat the infection will enter the milk supply, thereby lowering human resistance to infectious diseases. Proponents argue that rBGH-treated cows have a slightly higher risk for mastitis only because they are producing more milk — and that, in any case, milk containing antibiotics would be detected by federal inspectors and destroyed. Nevertheless, given reports that enforcement is lax, there does seem to be a possibility that the use of rBGH could result in higher levels of antibiotics in some of the milk sold to consumers.

The second concern, less publicized but more troubling, is that milk from rBGH-injected cows contains slightly elevated levels of insulin-like growth factor-1, or IGF-1. Some studies show

this protein, naturally present in all milk, can cause acromegaly, a disease that enlarges the hands, feet, nose, and chin. IGF-1 has also been associated with higher rates of colon and breast cancer. But David Barbano, a professor of food science at Cornell and head of the Northeast Dairy Foods Research Center, has written that the increase in IGF-1 levels is smaller than the normal variations which occur from cow to cow.<sup>3</sup>

That finding reflects a broad consensus of opinion among researchers. For example, in 1991 Norman Kretchmer, professor of nutritional sciences at the University of California at Berkeley, wrote a commentary in the journal *Pediatrics* arguing that IGF-1 in milk from treated cows "appears only in negligible quantities." He added: "In the manufacture of [infant] formula, an additional heating process destroys any residual hormone [IGF-1]."<sup>4</sup> (The American Academy of Pediatrics, which publishes *Pediatrics*, has not taken a stand on rBGH.)

Finally, opponents say rBGH stresses cows, and that regular use will result in illness and early death. Again, study results vary. But even if the opposition's most dire predictions come true, the result would simply be the end of rBGH as a commercial product. Consumers wouldn't be harmed and Monsanto would lose its investment (estimated at \$300 million to \$1 billion).

## The Enemy is Biotech

PERHAPS THE ONE THING BOTH SIDES AGREE on is that the biotechnology which has produced rBGH is as controversial as the hormone itself. Even opponents concede that synthetic BGH is identical to a cow's natural BGH; injecting the animal with large doses of natural hormone, in other words, would have the same consequences as using the synthetic. Because rBGH is manufactured with genetic-engineering techniques, the controversy is much more than a dispute over mastitis and growth factor-1.

Biotech companies such as Mon-

santo fear that if the public is unwilling to accept applications of genetic engineering such as rBGH, its hopes of developing a multibillion-dollar market for bioengineered foods will vanish. (In May, the FDA approved the first genetically altered food, a tomato developed by Calgene Inc., a biotechnology company based in Davis, California. An article in the *New York Times* reported that the biotechnology industry is calling the tomato, dubbed Flavr Savr, "a vanguard product that will soon be followed to market by dozens of other products improved through genetic manipulation.") Agriculture is one of the few sectors of the world economy in which the U.S. is still the undisputed leader. Bioengineered foods, proponents contend, could mean more American jobs and a better balance of trade with competitors in Japan and Europe. But not if overly burdensome regulations are enacted. Activists, however, say these products carry the potential to contaminate the food supply in dangerous, unpredictable ways.

Despite the lack of firm evidence showing that rBGH causes health problems in humans, opponents may be winning the public-relations battle. Elizabeth Darrow, a national organizer for Mr. Rifkin's Pure Food Campaign, says that some 250 supermarket chains, food distributors, and other companies have agreed not to sell or serve dairy products from cows treated with the synthetic hormone. Most prominent among the antis is Ben & Jerry's, the Vermont-based ice-cream maker that's invested heavily in a pro-environment image.

Ms. Darrow asserts that the fight against rBGH is just the first step in efforts to stop all genetically engineered foods from reaching the market. "By saying no to bovine growth hormone," she says, "we are making people address the hazards of genetic engineering. These hazards have really not been looked into."

Counts Mr. Urbanchuk, the agricultural economist: "By raising fears in such an intense fashion, [activists] have chilled the ardor of a lot of [companies] to look into the development of technology that would be beneficial."

<sup>1</sup> Jonathan Rauch, "Spilled Milk," *National Journal*, September 14, 1991; pp. 2210-2214. <sup>2</sup> Dale Heien and Cathy Roehm West, "The Nutritional Impact of the Dairy Price Support Program," *The Journal of Consumer Affairs*, Winter 1988; pp. 201-219.

<sup>3</sup> David Barbano's fact sheet on rBGH can be obtained via the computer database Internet. Issue the command telnet cce.cornell.edu. Log in as "guest." From the main menu, select "5" for "FOOD," and then "2" for "SAFETY." The name of the file is "bST fact sheet." <sup>4</sup> Norman Kretchmer, "Why Not Have More Milk?", *Pediatrics*, November 1991; pp. 1056-1057.

# Labels Launch Lawsuits

WHEN DISTRIBUTION OF MILK FROM COWS TREATED WITH the synthetic growth hormone rBGH was approved this past November, opponents were hoping the federal Food and Drug Administration would require that dairy products from treated cows be labeled.

But the FDA didn't take the step, explaining that because "there is no significant difference between milk from treated and untreated cows," it lacked the authority to require special labeling. The agency even went one step further, suggesting that food companies and state regulatory agencies that wish to label products which do not come from rBGH-treated cows should conform to a set of proposed guidelines. Among them:

- Because BGH is naturally present in all milk, a labeling statement that a product is "BGH-free" would be false.
- There is no compositional difference between natural BGH and recombinant BGH, so a label saying a product is "rBGH-free" would be deceptive.
- Although labels that say a product comes from cows not treated with rBGH would be acceptable, it should be accompanied by "proper context," stating that no significant difference has been found between milk from treated cows and from untreated cows.

Because the guidelines are voluntary, they do not have the force of law. That hasn't discouraged Monsanto, which manufactures the dairy hormone, from taking an aggressive approach toward companies that it believes have violated the guidelines. Monsanto has sued at least two dairy processors and threatened to sue others for what it contends are misleading labeling claims. The company has also sent letters to thousands of retailers warning them to comply strictly with FDA's guidelines.

One of the lawsuits, filed in federal court in Chicago, claims that Swiss Valley Farms of Davenport, Iowa, is falsely implying

that its products are safer than those made from rBGH-treated cows. Tom McDermott, a Monsanto spokesman, told the Wisconsin State Journal that the lawsuit was justified because Swiss Valley's practices, if allowed to continue, "will cause irreparable injury to Monsanto.... We believe what Swiss Valley is doing here is impugning the safety and wholesomeness of the majority of milk sold to the consumer."

In a letter to grocery stores, Monsanto vice president Walter P. Hobgood warned: "Monsanto has taken action against one milk cooperative/processor for advertising and promotional activities and using labels about bovine somatotropin [or BST, another term

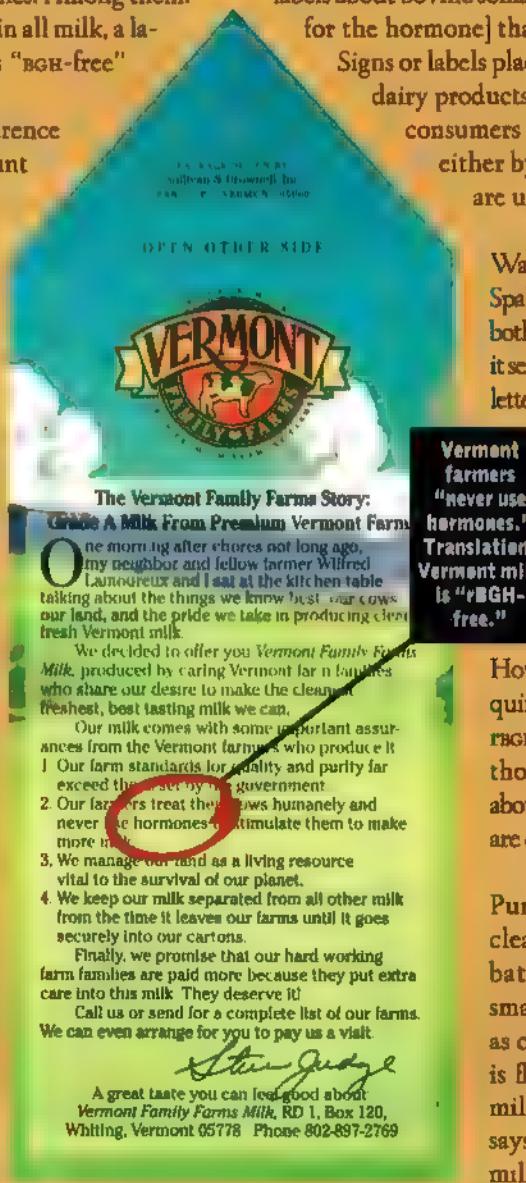
for the hormone] that we believe are misleading.

Signs or labels placed on or near milk and other dairy products that are false or that mislead consumers about bovine somatotropin, either by what they say or fail to say, are unlawful."

In addition, Monsanto's Washington-based law firm, King & Spalding, is going after companies both large and small. In one instance, it sent a three-page "cease and desist" letter to the Natural Way, a small natural-food store in Webster Groves, Missouri, ordering it to stop advertising that it sold "BGH-free cow's milk."

Such efforts haven't derailed critics of rBGH. In April, Vermont Governor Howard Dean signed legislation requiring that dairy products from rBGH-treated cows be labeled, even though he said he was worried about a court challenge. Other states are considering similar legislation.

Elizabeth Darrow, of the Pure Food Campaign, says it's clear why Monsanto is so combative: Milk sold by several small producers that's certified as coming from untreated cows is flying off the shelves. "Their milk has been selling out," she says. "They can't keep [rBGH-free milk] in stock."



# the compact

text by andrew rudin

I am writing this article with the help of a 9-watt compact fluorescent lamp (CFL) over my home-office desk, not doubting for a moment that, if I need to have inexpensive lighting, compact fluorescent lamps are one option.

# fluorescent

photographs by pete mcgarth

COMPACT FLUORESCENT LAMPS ARE LIKE margarine. Those who want to sell us on the substitute are stuck with comparisons to "the real thing," whether that be incandescents or butter. CFL manufacturers try to imitate the color, texture, shape, and price of "real lamps." As with margarine, the reference to the "real thing" always flatters the real thing. The more we make CFLs like their incandescent counterparts, the higher esteem we inadver-

tently attribute to incandescent lamps. Then we wonder why CFLs aren't being used universally. ¶ Certainly, CFLs are appropriate to some light tasks. I use them in my desk lamp, in my office ceiling fixtures, on my porch, and in my basement. But not over the bedroom mirror. CFLs work, but not everywhere. ¶ I am irritated, therefore, by those who over-promote CFLs, particularly the 133 U.S. electric utilities that offer 196 residential lighting pro-

# boondoggle



grams, 93% of which promote CFLs<sup>1</sup>. As we pay utility stockholders to get them installed, 25% to 50% are removed by homeowners who claim that CFLs are too dim, heavy, expensive, and odd-shaped. They can flicker, hum, interfere with TV remote controls, not turn on when they are cold, and might zap our brain cells with electromagnetic fields. So, why are we paying your electric utility to encourage our fellow ratepayers to screw them into sockets? Because we are too busy basking in feel-good environmentalism.

### What Market Barriers?

FLUORESCENT LIGHT AS SUCH HAS NEEDED no subsidy. The fluorescent lamp was commercially released in April 1938. Sales increased to \$250 million by 1941, proving a marketing success, by any standard, in competition with the incandescent lamp. Today, most commercial lighting is fluorescent, while at the same time, most residential lighting has remained incandescent.

Even though a 6-watt, 6-inch fluorescent tube has been available since the early 1940s, manufacturers have since sought a direct replacement for incandescent lamps that would screw into standard sockets found mostly in residences. Such a compact fluorescent lamp was introduced to America in 1983. For the intervening 45 years, American homeowners could compare fluorescent and incandescent light sources and have not rushed to buy CFLs.

A rational goal for promoting CFLs is to reduce the environmental damage and economic waste associated with inefficient lighting. With all promotion of CFLs, we have missed the goal of reducing the prevalence of relatively inefficient incandescent light-

ing. An internal study by General Electric revealed that, while utilities and environmentalists were promoting CFLs between 1986 and 1991, the number of lamps in American households had increased by about a third. The typical household added one additional fluorescent lamp in the five year period. At the same time, according to GE's study, the average household added over seven incandescent types of lamps.

### The Environmental Spin

COMPACT FLUORESCENT LAMPS ARE not environmentally benign. It takes a lot of misunderstanding to call them earth lights, or green lights, or smart bulbs. Whom are we trying to fool? What's green about a CFL is the way it often looks in a photo, because its mercury source casts greener wavelengths of light.

Efficient use of electricity does not benefit the environment. The conversion efficiency of energy to fluorescent light is 6.8%, only a bit better than an incandescent. Turning off an incandescent lamp is about 30 times more environmentally beneficial than replacing it with a CFL.

Many of the CFLs weigh up to 20 times more than their incandescent counterparts. This additional weight has an impact on transportation to market and stability of some of the lamps into which the CFLs are installed. The mass of CFLs adds material to the waste stream that is not present in incandescent lamps. Within the lamps and ballasts are phosphors, mercury, electronic components, lots of plastic, and ballasts. For example, inside a 27-watt Panasonic Electronic Twin Light Capsule, there are four phosphor-coated glass tubes welded together, a

metal lamp base, 22 electronic components, 4 plastic components, 8 metal connectors, a printed circuit board and droplet of mercury about 1 mm in diameter. Inside a standard incandescent lamp, one finds brass, glass, a small amount of other metal, and usually a mixture of argon and nitrogen gases — far less harmful material than the ingredients in CFLs.

The packaging that protects pricey compact fluorescents also adds more mass to the waste stream than the packaging for incandescent lamps. Some CFLs are packaged in polystyrene as well as stiff, colored cardboard containers. Rebates from electric utilities hide the true cost of CFLs with our dollars of subsidy.

Mercury is toxic. Consider a ceiling fixture in a day-care center, designed for incandescent lamps but now weighted by CFL replacements, that falls onto the floor. If it breaks upon the floor, the mercury will be extremely difficult to remove from the facility. Proponents may reply that CFLs remove more mercury from our environment because they require less release of mercury at the point of electrical generation. While this is true, it has little relation to the higher concentration of mercury on the day-care floor.

The EPA estimates that disposing of fluorescent tubes while recovering the mercury costs \$0.50 per 4-foot tube. Perhaps CFLs will eventually be discarded in this fashion, adding to their cost.

### What is the Energy Cost of a CFL?

THE MANUFACTURING OF CFLS TAKES considerable energy. While no major CFL manufacturer has published any data on the amount of electricity needed to manufacture a CFL, research at the Technical University

of Denmark reports that the material content of CFLs require 1.7 kWh to manufacture, while an incandescent lamp requires only 0.29 kWh. Yet a Swiss magazine states that CFLs require thirty times the energy needed in the manufacture of their incandescent counterparts. A study from Munich Technical University states that the energy to produce a CFL (7.5 kWh) is eight times that for an incandescent. A Sylvania sales engineer suggests that the energy to manufacture a CFL may be between 16 and 80 kWh, depending on the estimated labor/energy split in the cost of the lamp. This additional energy is reflected in higher prices, along with the greater labor costs to assemble CFLs.

### Blinded by the Dim

THE LIGHT OUTPUT OF COMPACT fluorescent lamps is exaggerated. Consumer Reports magazine found "Our tests of light output showed that some manufacturers of fluorescents get carried away, exaggerating brightness claims on their bulb's package." Panasonic's touted 60-watt replacements "fell 300 lumens shy of the usual 850 or so that soft-white 60-watt bulbs put out." The light output of a CFL from another manufacturer fell 750 lumens short of the 100-watt incandescent lamp they claimed to replace.

Many, many other experts agree that these lamps are in one way or another deficient. Have you asked your parents or grandparents to read by a CFL? Zealous environmentalists are often the

exception, but even that is fading. The Rocky Mountain Institute has been a leading over-ponent of CFLs. Hunter Lovins is its president and issued her complaint in the July 1992 issue of *Popular Science*. "On this score, Hunter Lovins provides a consumer's counterpoint to new technology. The energy-saving compact 7-watt fluorescent in the Institute's bathroom, Hunter complains, 'doesn't provide enough light for you to read a magazine on the can.'"



### Don't Blink

WE WON'T SOON FIND CFLS IN BLINKING traffic signals. I turned electricity on and off every few seconds to two medium-base lamp sockets. One socket contained a General Electric soft-white, 120-volt, 40-watt incandescent light bulb. The other socket contained a compact fluorescent lamp. The incandescent lamp withstood the pulses of electricity for more than

1 The original manuscript from which this article was adapted is lengthy and contains 40 footnotes with references. For a copy of the total article, send \$10 to the author at 7217 Oak Avenue, Philadelphia, PA 19126.

800 hours. None of the identically pulsed compact fluorescents lasted more than 150 hours — about 1/70th of their rated life.

### Wasting Electricity Efficiently

IMPROVEMENTS IN EFFICIENCY OFTEN lead to less conservation. This has been proven true with automobiles, and is likely true with lighting. For example, we know that the improvements in efficiency of street lighting have led to higher levels of light on roads, with increased rather than decreased wattage in spite of more efficient lamps. Improving the efficiency of lighting does not translate directly into electrical savings. We can waste a lot of electricity efficiently.

### So, Let's Pay the Utilities?

AS CFL PROMOTERS TRY TO OVERCOME the lack of market acceptance by encouraging rebates, lamp rentals, and give-away programs, these perpetual utility giveaway and rebate programs may actually decrease market acceptance, discouraging brand loyalty. In comparison with common market distributors of lamps — hardware stores, electrical wholesalers, home centers and supermarkets — electric utilities can borrow money at more favorable rates, bulk purchase at great economy of scale, and distribute the lamps free of charge while charging the costs to the ratepayers. This effectively wipes out other markets for these lamps. In other words, utility rebate programs can have the opposite of their intended effect. I recently visited Zurich and Venice where CFLs are far more prevalent, without any foolish utility shareholder subsidies.

A 1993 study of the effectiveness of a rebate program in southern New York State compared the stocks of lighting dealers there and in northern Pennsylvania, where there were no demand-side management programs for lighting. "In nine out of ten cases, higher percentages of control group [PA] dealers reported that they have the qualifying measures in stock than did the NYSEG [NY] dealers."

### What Users Really Say

IN 1992, ALMOST FOUR HUNDRED residential customers and ten retailers in five major markets in the United States participated in six focus groups in Boston and San Francisco, 178 telephone interviews with residential customers who had purchased CFLs through utility-sponsored programs and 150 customers who knew about CFLs but never purchased them. Here are some conclusions from their report:

The drawbacks of CFLs currently outweigh their benefits. Most users are unlikely to give CFLs a strong recommendation. They believe the products are overpriced. CFLs do not produce enough light for major applications. The term "fluorescent" has strong workplace overtones. CFLs are rated poorly even by "satisfied" users on eight attributes. Utility promotions have done little to break down price and performance barriers. Lighting specialists view CFLs as temporary technology.

Existing CFLs have very limited applications in existing fixtures. They are not dimmable, while about a third of American dining and living rooms may have dimmers. CFLs do not have multiple levels of light similar to the incandescent lamps with three vary-

ing wattages. Three-position lamp switches will vary the light output of incandescent lamps, but will operate a compact fluorescent only at its highest light output.

Compact fluorescent lamps use less electricity than the incandescent lamps they replace. Those of us using CFLs soon learn of their drawbacks and often limited application. Their light is more diffuse, making them seem less bright. They are heavier, larger, and much more expensive. From the point of view of an electric utility, CFLs often have a low power factor



and create harmonic distortion. From the environmentalists' point of view, their contents are toxic and add mass to the waste stream.

### Introducing Balance

THE OVER-PROMOTION OF CFLS IS AN example of the power of non-technical environmental lobbyists who have more experience in popular persuasion than filling lamp sockets. When power factor, total harmonic distortion, operational com-

promises, disposal costs, and more reasonable lighting and control alternatives are considered, CFLs lose much of their glamor. Although improvements in these lamps are occurring all the time, the disregard of technical and behavioral problems with CFLs demonstrates the old adage that "haste makes waste."

CFLs conserve electricity because they are more efficient than incandescent lamps. In the final analysis, however, lamps do not use electricity; people do. To continue to over-promote compact fluorescent lamps is, at best, imprudent for electric utilities and their regulators. There are inherent values in using less light, no matter what the type of light source. Let's learn from restaurant owners — the lower the light level, the higher the cost of the meal.

The lighting industry has understood this for more than fifty years. At a 1940 Conference on Fluorescent Lighting, W.P. Lowell Jr. of Hygrade Sylvania Corporation said about fluorescent light: "Why is it demanded? For many reasons: its daylight color, soft quality, reduced shadows, novelty (it's new, modern, smart), real or imaginary economy. But don't worry too much about those who think they are saving money by using fluorescent lighting to save a few watts. If the overall value — combining the sheer dollars and cents with all other qualities — if the net value is not right, the product will fall of its own weight. You can't fool all the people all the time."

We now know that margarine isn't very good for us, either. Maybe it's time we learned that moderation in use is the best way to conserve energy, too.

# Too Early to Quit CFL Programs

BY BILL ORTHWEIN, ENERGY-EFFICIENCY & RENEWABLE ENERGY CLEARINGHOUSE

*When used (and disposed of) properly, compact fluorescents make sense and utility programs accelerate market development.*

WHILE I AGREE THAT THERE ARE ONGOING PROBLEMS ASSOCIATED WITH CFLS, MORE TIME NEEDS TO BE GIVEN TO RESOLVING THE PROBLEMS BEFORE RESIDENTIAL CFL PROGRAMS ARE ABANDONED ALTOGETHER. WHEN CFLS ARE USED IN THE RIGHT APPLICATION (WHERE THEY ARE NOT TURNED ON AND OFF FREQUENTLY) THEY WILL LAST ABOUT EIGHT TO TEN TIMES AS LONG AS INCANDESCENTS AND CONSUME A LOT LESS ENERGY.

Mr. Rudin stated that the promotion and distribution of CFLs has not reduced residential incandescent lighting. However, according to the Worldwatch Institute, sales throughout the world of highly efficient compact fluorescent lamps jumped 23% in 1992, and since 1988, sales in North America have quadrupled.

There is no doubt that price is a major market barrier for CFLs. However, as the technology improves over time and the demand increases, manufacturers' economy of scale will be enhanced and price decreases will follow. Utility programs will accelerate market development and investment for CFLs.

While CFLs cost more than incandescent bulbs, their lower operational and maintenance costs (energy use and labor involved in changing bulbs), along with the avoided incandescent replacement costs (seven to eight bulbs for each CFL) will more than defray the purchase price. Because so little is known about the lifetime of CFLs in residences, a cost/benefit analysis was done by the Washington State Energy Office Extension Service using

three different lifetimes—6,000, 8,000, and 10,000 hours. Assuming a \$25 price for a CFL, the benefits outweighed the cost even in the worst-case scenario of a 6,000-hour life span.

As manufacturers become more engaged in CFL products, light fixtures specifically designed for CFLs are becoming available. Dedicated fixtures designed for the explicit operation of pin-based CFLs offer the most effective and long-term solution for efficient residential use. Screw-in adapters make many standard lamps and fixtures CFL capable. Even an adapter that permits an incandescent dimmer to dim a quad-tube CFL lamp has been developed.

Mr. Rudin mentions that in cold environments many CFLs flicker and that CFLs often hum. However, electronically ballasted units start instantly and do not hum as magnetically ballasted CFLs do.

Mr. Rudin's points regarding the environmental impact of CFLs are misleading. He states that a 60-watt incandescent lamp produces only 40% of the carbon dioxide emitted by a lumen equivalent 15-watt CFL. But 400% is the true amount of carbon dioxide emitted by incandescents when you figure in the ten incandescent bulbs that will be used in the lifetime of a CFL. Similarly, the material content of CFLs require 1.7 kWh to manufacture, while incandescents require 2.9 kWh (or ten times the .29 kWh proposed by Mr. Rudin) to produce the light equiv-



alent of CFLs. And the materials going into CFLs, 20 times more than that going into incandescent bulbs, is not the landfill hog proposed when you factor in that CFLs are changed about ten times as infrequently and therefore aren't disposed of as often. Not to mention that ways of recycling the materials found in CFLs and bypassing landfills altogether are being explored by both the public and private sector.

Improvements in efficiency often leads to less conservation, according to Mr. Rudin, and he gives increased use of automobiles as an example. However, cheap fuel and rising populations—not more efficient cars—are the impetus for the increase in driving. Replacing incandescent bulbs with CFLs doesn't necessarily prompt increased light use. And homeowners can purchase occupancy sensors or timing devices to compensate for any tendencies to use more of their efficient lighting products.

While it is true that CFL lumens depreciate over time, the lumen level will only fall from 80 to 85% of the initial lumens at the end of its life. Mr. Rudin's criticism of CFLs not emitting enough light can be traced partially to overheating. Heat generated in fluorescent lamps can result in 15 to 20% less light output and reduced efficacy. But manufacturers are adopting new design solutions that will optimize the thermal performance of CFLs.

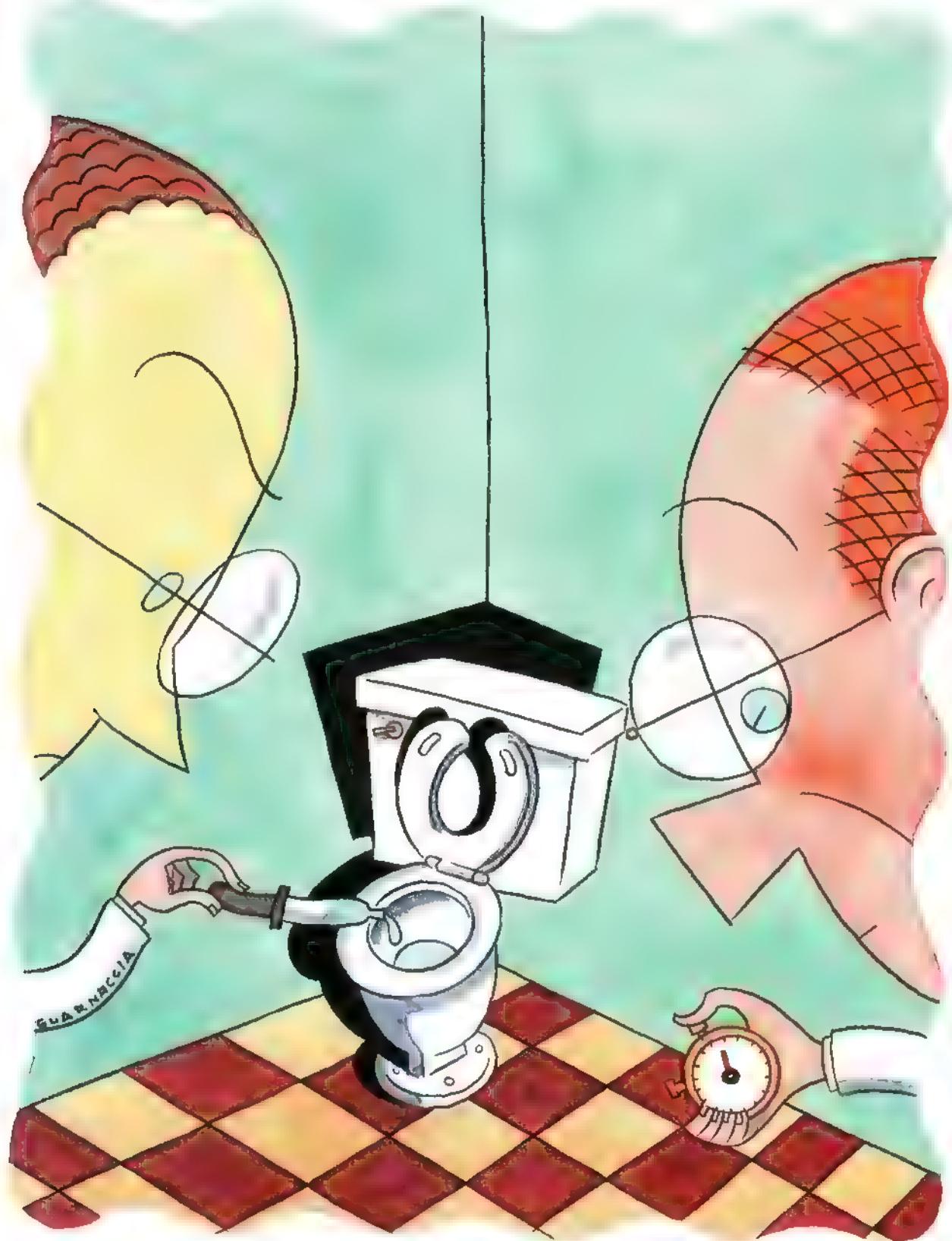
*A new federal law is forever changing the com-mode as we know it. While the plumbing industry and environmentalists alike have spread some confusion over the new wave of toilets, surveys show that many models do save both water and money.*

BY ROBERT KOURIK

ILLUSTRATION BY STEVEN GUARNACCIA

# building a better toilet

LUMINARIES OF TOILET FOLKLORE HAVE LONG HELD THAT THE English engineer Thomas Crapper freed humankind from the chamber pot when he invented the water-evacuated toilet circa 1860. I hate busting a popular myth, but the toilet gurus have it wrong. According to the World Book Encyclopedia, an English cabinet-maker named Joseph Bramah had the first patent, in 1778, for the "modern" flush toilet. Mr. Crapper, who improved on Mr. Bramah's work, was fortunate enough (or cursed, depending upon your point of view), to have a name that



lends itself nicely to the material at hand. "Crap" sounds like what it means. I see no reason to change the etymological origins for such a terse, unpretty, yet expressive word.

However, there is a need to update *GARBAGE* readers on the sculptural, mechanical, hydrological (but not scatological) advances made with the development of the truly modern crapper — the ultra low-flush (ULF) toilet.

Contrary to what you might expect, some of the old-fashioned (circa late-1800s), high-tank toilets consumed as little as one gallon per flush (depending on the design of the bowl). Our modern toilets still rely on "gravity assistance," as they did in Thomas Crapper's day, but their water usage has surged. Much of this increase came with the effort to reduce the decibels of the flush. Potty designers increased the amount of water so as to develop a silent, swirling

**It is estimated that 9,000 gallons of pure drinking water are annually flushed by each and every American, all to dispense with a comparatively meager 130 gallons of solid and liquid bodily waste.**

vortex to evacuate the bowl. Nowadays, the standard toilet chugs from 3.5 to 5 gallons with every flush. Some guzzle as much as eight gallons. According to the July '90 issue of *Consumer Reports*, toilets consume 38% of a household's water — more than any other fixture. It is estimated that 9,000 gallons of pure drinking water are annually flushed by each and every American, all to dispense with a comparatively meager 130 gallons of solid and liquid bodily waste.<sup>1</sup>

But that's all changing. On January 1 of this year, manufacturers began flushing water-wasting toilets out of their inventories. A federal law designed to promote resource efficiency, the Comprehensive Energy Policy Act of 1992, makes it illegal to manufacture the old-fashioned potty found in almost every American home. (The manufacturers have a grace period during which they

can sell off existing inventory of the 3.5-gallon toilets.) In its place, the Energy Act is ushering in a new wave of water-efficient toilets that consume no more than 1.6 gallons per flush.

The new law does not mean that toilet police will force you to replace your old potty. But because the Act bans production of high-volume toilets, builders of new homes and homeowners who renovate their bathrooms will find only ULF models from which to choose. (Starting in 1997, the Energy Act will require that new toilets for business and industry must also be ULF models.) That prospect has generated a good bit of concern as to whether ULFs can handle America's effluent.

In recent years, fear and confusion over the low flushers was fueled by two camps — conservationists and the industry (comprised of manufacturers and plumbers). Each side lobbed PR sheets at the press, predicting grand scenarios of glory or doom, depending on whom you were listening to. It often appeared that the industry didn't want these "newfangled" toilets and actually fought legisla-

tion requiring them. Plumbers predicted clogged toilets, plugged sewer lines, and endless hours spent on call-backs (the trade term for the much-dreaded return to a job site for freebie repairs). Instead of meeting the regulations head-on and welcoming the chance to sell a new product to old and new customers alike, the plumbing trade journals of the '80s and early '90s practically predicted the failure of modern plumbing as we know it. Environmentalists were just as deceptive. They painted a Pollyannaish picture of tremendous water savings and no mechanical problems.

Among the public, performance anxieties over water-efficient toilets arose in the mid-1980s, when local ordinances mandating their use were first

being considered. Back then, the predominate low-flush commodes consumed just 0.8 to 1.0 gallons per flush (as little as one-half the volume of the current federal mandate). Yet the early results from the few existing studies were encouraging.

Personal criteria for evaluating the performance of low-flush models generally pertain to toilet-clogging, and whether they increase the need for extra flushes and cleaning. Surprisingly, a 1986 study of 88 homes in a Phoenix subdivision, which compared a 0.8-gallon model with the standard 3.5-gallon toilets in a neighboring subdivision, found that double-flushing and clogging were reported by more of the users of conventional toilets.<sup>2</sup> But a study conducted the same year by the Stevens Institute of Technology of one-gallon toilets in four homes in Columbia, Maryland, found that double-flushing averaged out to once every ten days, per person — about twice the number of double-flushes compared with the study's four standard toilets.<sup>3</sup> (A counting device attached to each toilet gave an accurate measurement, not just the user's recollection.)

Things weren't all rosy in the pioneering era of the low-flushers. The Phoenix study also found that users of the low-consumption models were more likely to encounter the dreaded "skidmarks," those brown streaks which remain on the porcelain bowl's wall after the flush. Designers of the new models have largely eliminated skidmarks by increasing the water seal's surface area. Meaning waste hits water, not porcelain.

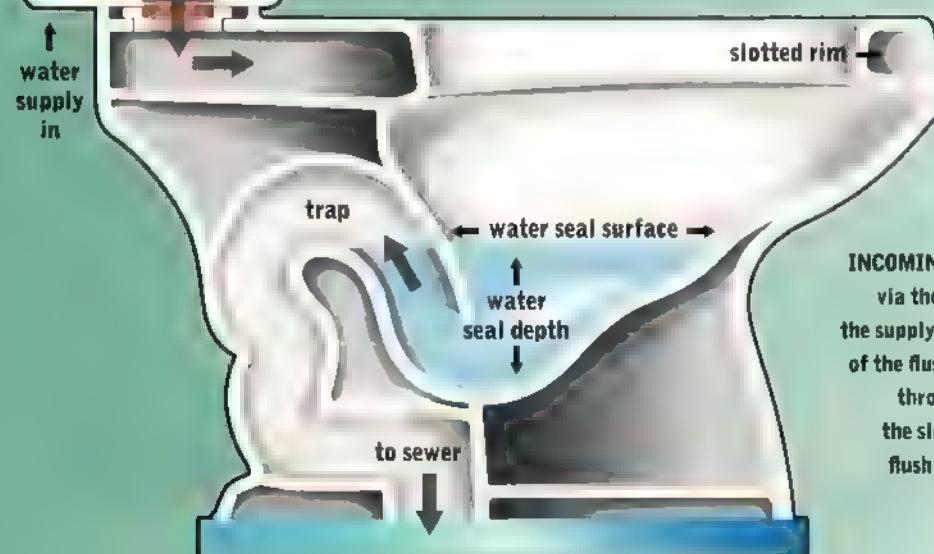
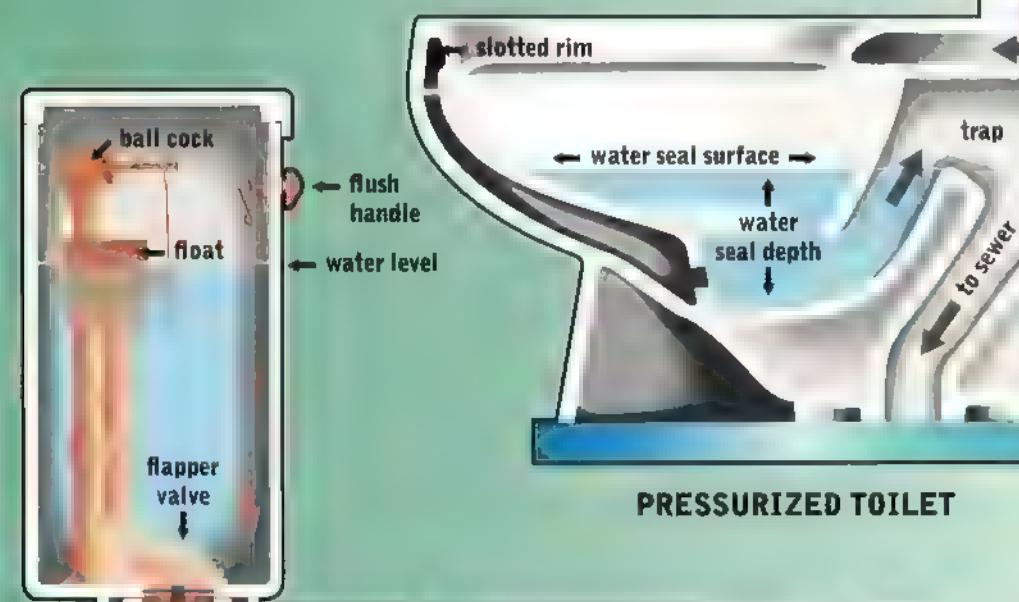
**THE TOILET WARS, IT SEEMS, ARE OVER** — manufacturers are realizing that griping won't alter the fact that the Energy Act has forever changed the commode as we know it. Designers have remolded and retooled, and now they're turning out a new line of water-wise water closets. There are dozens of designs to choose from: round seats and elongated seats, low-risers and high ris-

<sup>1</sup> Damann Anderson, P.E., and Robert Siegrist, P.E., "Performance of Ultra-Low Volume Flush Toilets in Phoenix, Arizona," (Madison, Wisconsin: RSE Group/Ayers Associates February 1986.), p. 1. <sup>2</sup> Anderson and Siegrist, op. cit. pp. 18-20. <sup>3</sup> Thomas P. Konen, "Field Measured Performance of the Eljer Ultra One/G Water Closet," (Hoboken, NJ: Stevens Institute of Technology, 1986).

# How ULF Toilets Rush the Flush

ULF toilets generally rely on one of two methods to utilize less water. A pressurized toilet uses water pressure from the home's pipes to compress air, producing a high velocity flush; a gravity-fed toilet uses the natural force of water dropping down from the tank to discharge the bowl.

AS INCOMING WATER FLOWS into the tank, trapped air is compressed. Depressing the flush button forces water through the slotted rim and into the bowl, creating a powerful swirl. This cleanses the bowl area and pushes water up the trap and towards the outlet.



INCOMING WATER FILLS THE TANK via the ball cock. The float shuts off the supply at the 1.6-gallon level. A flip of the flush handle releases water down through the flapper valve and into the slotted rim. Spurred by gravity, flush water from the rim evacuates the bowl through the trap.

**GRAVITY-FED TOILET**

ers, plain porcelain and psychedelic purple, no-frills potties and sleek designer models. Retail prices range from under \$75 to over \$600, with many models going for \$75 to \$125. (See "A Sampling of Water-Wise Toilets," p. 57.)

How many gallons will an individual save by switching to a ULF toilet? While the numbers aren't as optimistic as those that were projected during the '80s, they are impressive nonetheless. A real-world survey in 1990 by Stevens Institute, which tracked 1.6-gallon toilets installed in 25 homes located in the San Francisco Bay Area, found the average water savings was 5.3 gallons per person, per day. This works out to a total of 1,935 gallons conserved annually. Overall, ULF toilets reduced total household-water consumption by 15% — even with a 16% increase in the number of flushes.

Low-flush toilets not only reduce the volume of water that's pumped into the home, but they also cut the flow of waste water that pours via sewers into treatment plants. Research at Pennsylvania State University indicates that reduced waste-water volumes can increase the detention time (the time the sewage is held in various ponds and tanks), enhancing the treatment process and extending the life of the plant.

To reduce water usage and keep the oomph in the flush, manufacturers have given the gravity-assisted toilet a make over. Perhaps the foremost approach has been to tinker with the toilet's gravitational devices to improve the fall of water from tank into bowl. A number of manufacturers have installed a "flush-valve sleeve," which regulates the flush so that only water from the top of the tank is utilized. Since the water has farther to drop, its velocity increases as it flows through the bowl. (See diagram, p. 55.)

Perhaps the most novel design for evacuating the toilet's bowl is the pressurized tank (a.k.a. the "flushometer tank"), which taps an ever-present source of energy to rush the flush: the pressure within the home's water pipes. The compressed air, which is stored in a horizontal water tank, thrusts the flush

through the bowl. (See diagram, p. 55.) The force of the "turbo-charged" water is equivalent to putting a typical gravity-fed tank some 60 feet in the air. That kind of velocity reduces the volume of water required to propel the waste. One problem: The loud growl of the power-assisted flush has led some homeowners to shy away from pressurized-tank models. Nevertheless, a recent survey conducted in Los Angeles found a pressurized ULF toilet garnered the highest performance rating.

**CONSUMER ACCEPTANCE OF LOW-FLUSH TOILETS** did not begin to take off until the late '80s, when various water-regulatory agencies and utilities (the purveyors of water) launched rebate programs ranging up to \$100 a toilet to replace water guzzlers. Some districts were motivated by drought or over-tapped water supplies. The staggering costs of building additional waste water-treatment facilities pushed other districts to embrace water-efficient toilets. For many, it was a bold move: Despite the above-mentioned studies, the case for the toilet-rebate program was based more on theory and projection than on historical data. Now, after several years of monitoring the real-world workings of ULF toilets, the data contradict the critics who assumed that a lower rate of water consumption would result in poor performance:

- ◆ The largest user-survey, conducted by the Los Angeles Department of Power and Water in 1992, found that 75% of the 9,000 respondents who purchased a ULF toilet would "very likely" buy another. A pressurized-tank model, American Standard's New Cadet (2172), received an 87% approval rating; the Mansfield Quantum (150-1) and the Toto Kiki USA (703/704) also got top billing.

- ◆ A 1992 study in Tampa, which used electronic monitoring to track water volume, revealed that total household water use was reduced by 16%. Just one of 38 users surveyed would not reinstall a low-flush toilet — she disliked the color of the porcelain.

- ◆ A 1991 survey of seven different models installed in 40 Bay Area homes found that 95% of the users said their ULF

toilets provided an adequate flush with everyday use. Performance-wise, 54% of the users said ULF toilets work better than conventional toilets; 35% said they work about the same.

- ◆ Four years ago the North Wales Water Authority (encompassing Boston) initiated a rebate program that offered \$75 to replace a standard toilet with a low-flush model. After the first year the program's manager, Peter Lukens, surveyed 50 random users. His findings: 48 people rated low-flush toilets "very favorable" (two were unhappy due to double flushing); 13 of the users did complain that low-flushers require more bowl brushing than conventional toilets.

What's the future of ULF toilets? Pretty darn good. Would New York City, with all of its fiscal woes, launch a three-year rebate program for more than one million ULF toilets if studies showed they didn't work? Although there are individual cases of plumbing disasters or dissatisfaction — as there are with any new technology — the consensus of surveys is that the vast majority of users are satisfied with ULF toilets. No doubt they're also happy with the direct and indirect savings gained by switching to water-wise water closets.

Contrary to the claims of some critics, the new toilets are not more expensive than their predecessors — and replacement is rewarded by payback. Consider the study published in *Consumer Reports*, which analyzed ten ULF toilets for function and cost-effectiveness: three pressurized-tank models costing from \$168 to \$285; and seven gravity-fed models that cost from \$100 (plus shipping) to \$240. To determine the return on investment, *Consumer Reports* calculated the cost of water and sewer bills in 13 cities relative to the average \$200 (in 1990 dollars and prices) purchase and installation cost of a ULF toilet. Annual savings ranged from \$16 a year in Dayton, Ohio, to \$62 in Houston. This equals a payback time of, respectively, 12.5 and 3 years. (The average toilet "life expectancy" is 20 years.) In the interim, purchase prices will continue to drop as demand increases. 

## A SAMPLER OF WATER-WISE TOILETS

MODEL NAME	MANUFACTURER	GALLONS PER FLUSH (GPF)	FLUSH TYPE	SUGGESTED RETAIL PRICE <sup>1</sup>				WATER-SURFACE AREA FOR ROUND BOWL <sup>2</sup>	
				ROUND/WHITE	ROUND/COLOR	ELONGATED/WHITE	ELONGATED/COLOR	SIZE	DEPTH
Alto	Mansfield Plumbing Prod 150 First Street Perrysville OH 44864 (419)938-5211	1.6	Gravity-fed	\$110	\$140	\$150	\$170	72 sq.in.	2 in
Atlas	Universal-Rundle 217 North Mill Street Newcastle, PA 16103 (800)955-0316	1.5	Gravity-fed	\$110	\$130	\$136	\$156	37.5 sq.in.	2 63 in
Crane-Miser	Crane Plumbing 1235 Hartrey Street Evanston, IL 60202 (please write only)	1.6	Gravity-fed	\$241	\$300	\$265	\$235	68 sq.in.	3 in
Cascade	Mansfield Plumbing Prod 150 First Street Perrysville, OH 44864 (419)938-5211	1.6	Gravity-fed, reverse trap flushing action	\$220	\$290	\$300	\$380	35 sq.in.	2 in
LF 16R	Microphor Inc PO Box 1460 Willits, CA 95490-1460 (800)358-8280	1.6	Gravity-fed	\$99	—	—	—	80 sq.in.	2 in
Quantum	Mansfield Plumbing Prod 150 First Street Perrysville, OH 44864 (419)938-5211	1.5	Pressurized tank	—	—	\$320	\$420	120 sq.in.	2 75 in
New Cadet	American Standard Attn. Consumer Assist. 1 Centennial Plaza Piscataway, NJ 08855 (800)223-0068	1.6	Pressurized tank	\$325	\$387-\$426	\$366	\$426-\$468	96 sq.in.	2 5 in
Preserver 2	Eler Plumbingware 17120 Dallas Parkway Dallas, TX 75248 (800)435-5372	1.6	Gravity-fed, flush valve sleeve, open slotted rim	\$140	\$173	\$160	\$198	95 sq.in.	2 5 in
Ultra-One/G	Eler Plumbingware 17120 Dallas Parkway Dallas, TX 75248 (800)435-5372	1.6	Gravity-fed, siphon jet	\$158	\$198	\$196	\$247	120 sq.in.	2 5 in
Wellworth Lite	Kohler Company Kohler, WI 53044 (800)456-4537	1.6	Gravity-fed	\$156	\$195	\$194	\$243-\$279	72 sq.in.	2.5 in
Tata	Toto Kiki USA, Inc 415 W Taft Avenue, Unit A Orange, CA 92665 (714)282-8686	1.6	Gravity-fed	\$134	\$160	\$169	\$203	64 sq.in.	2 25 in

PLEASE NOTE: <sup>1</sup> Prices are for relative comparison only. These prices will vary greatly with actual retail prices.  
<sup>2</sup> Water-surface area and depth are for standard (round) bowls only. Measurements will vary with an elongated toilet.



# Proposed: Adaptive Policies

**W**E LOOK TO SCIENCE AS A source of expertise that can help us make better political decisions. Several assumptions underlie this obvious statement. First, we assume that experts can transmit objective information to policy makers in a way that will have a positive influence on the formulation of policy. Surely the *sine qua non* of influential scientific advice is objectivity. Yet my own experience suggests that, when Congress begins to deal with controversial problems, there are always qualified, highly credentialed experts at the service of each side of the issue. From radon to tobacco, electromagnetic fields to endangered species, global warming to solar energy potential, there is never a shortage of putative objectivity.

Perhaps we should view objectivity not as a commodity offered by scientists to policy makers, but as the constant goal toward which science strives, and which inevitably disappears in policy debate. Data derive their policy meaning from the context of human values. In political debate, objective data do not exist. Successful politics, not good science, resolves conflicting values.

This argument leads to a second assumption about science advice: that research into complex issues can offer predictive tools by which better policy can be formulated.

Politicians and scientists sometimes participate in a tacit, mutually aggrandizing conspiracy about prediction. Politicians would much prefer to fund research for tomorrow than to make difficult decisions today — decisions that might get them thrown out of office. Scientists would much prefer to have generous support for their research than to point out that understanding a phenomenon is not the same as predicting it. Predictions are just big hypotheses. Predic-

tions highlight uncertainty; they don't reduce it.

The science advice that Congress receives from non-advocacy scientific organizations typically urges more research. The question is not whether such recommendations are appropriate — of course they are — but whether they address the hard issues facing policy makers. When "more research" is identified as a policy-making requirement (rather than a technical need), the implication is that new results will allow a level of certainty that will help overcome political debate and inertia. This argument is overrated. Calls for "more research" may themselves reflect a bias about the role of science in policy making.

The worthwhile pursuit of objectivity in science is not easily transferable to the policy process. This difficulty does not merely reflect the character of ignorant and self-serving politicians; it also reflects the intrinsic nature of the scientific method. The siren song of scientific objectivity can draw us onto the rocks of legislative inaction by creating rhetorical gridlock on the one hand, and by perpetuating the illusory expectation of better prediction through more research on the other.

We now arrive at a third assumption which underlies science advice: that policy issues with complex scientific ramifications require scientific input as a prerequisite for wise policy formulation. I believe this to be true, but commonly misunderstood.

The questionable assumption here seems to be that science is hard and requires credentials and years of practice,

while policy is easy, and flows organically from scientific consensus. This is rarely the case. It is not clear that expertise in science implies wisdom in policy.

Policy makers today are not faced with

**"I'm advocating a type of conscious, trial-and-error policy-making that mimics the scientific method. The trick is to test the consequences of our political choices by creating feedback loops between adaptive policy decisions and scientific research."**

a shortage of information. What they often lack, however, is reliable new information that they can use. Science advice to Congress often falls on deaf ears because it is not user friendly. In a vain effort to be accurate, measured, unbiased, and comprehensive, science advice can also be irrelevant, impractical, untimely, and incomprehensible.

# We the People

Domestic Tranquility, provide for the common Defense, and to maintain the Constitution.

Done,

At a Convention of the Year One  
of the Independence of the United  
States of America,

Delaware

John B. Brown  
John D. Borden  
C. D. Borden  
John D. Borden  
John D. Borden

22]: the energy loss of the

$$\frac{dE}{ds} = \frac{G}{5c^5} \sum_{ij} \vec{Q}_i \vec{Q}_j$$

$$= \rho (x_i x_j - \frac{1}{3} \delta_{ij} r^2)$$

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PHOTOGRAPH BY TOM WOLFF

Some may consider these observations to be "anti-scientific." On the contrary, I fear that it is unrealistic expectations about what science can deliver to society that could ultimately create an anti-science backlash. I am trying to avoid that unfortunate consequence. Science offers us enlightenment through understanding, and freedom through insight. Scientific understanding and insight do not imply a mechanistic, predictable human world, but sometimes we act as if they do. As a result, we often match the needs of politics not with the strength of science — understanding — but with the weakness — prediction. Perhaps we can turn this around.

I WOULD LIKE TO SEE POLICY MAKERS AND SCIENTISTS WORK TOGETHER TO DESIGN INCREMENTAL, ADAPTIVE PROGRAMS THAT MOVE TOWARD POLICY GOALS ALONG EVOLVING PATHWAYS. I'M ADVOCATING A TYPE OF CONSCIOUS, TRIAL-AND-ERROR POLICY MAKING THAT MIMICS THE SCIENTIFIC METHOD. THE TRICK — WHICH WE HAVE YET TO MASTER — IS TO TEST THE CONSEQUENCES OF OUR POLITICAL CHOICES BY CREATING FEEDBACK LOOPS BETWEEN ADAPTIVE POLICY DECISIONS AND SCIENTIFIC RESEARCH.

We should expect mistakes in the policy process, just

as we do in science. Government programs should regularly include a mission-oriented research component whose function is assessment of the impact and efficacy of incremental policy decisions. Science advice would therefore become a real-time component of the policy process, and the policy process would be a principal stimulus for research. This approach also allows time for basic research to deliver results for the next cycle of decisions.

The character of policy making and science advice both must change if there is ever to be a direct synergism between politics and research. Political expediency will always play a greater role in policy making than will analytical thinking, scientific or otherwise. This is probably an objective fact: 2,000 years of recorded human history offer strong experimental confirmation. But we can, and must, seek ways to better integrate our growing body of scientific knowledge and technological expertise with our needs as human beings living in a global society.

CONGRESSMAN BROWN (D-Calif.) is chairman of the House Science, Space, and Technology committee. The text is adapted from his recent speech to Sigma Xi's forum on science and public policy.



# A Tree Grows on Fresh Kills

**A**S A GENERATION OF URBAN LANDfills nears the end of its life span, landscape architects are attempting to transform these highly disturbed sites into something resembling their "natural" state. Because landfills have steep slopes and a tendency to "slump out," or settle, they are generally unsafe for housing construction.

That's good news for high-density urban areas. Freed from development pressures, a closed landfill is virtually guaranteed open space. If the landfill can be returned to a native habitat, it might even act as a "wildlife corridor" to adjacent natural areas, thereby uniting disparate ecological units.

Unfortunately, most state regulations for landfill closure do not allow woody vegetation to be planted atop a closed landfill; such regulations severely limit complete biological restoration. Solid-waste regulators are worried about tree roots penetrating the clay cap, the barrier that seals in water-borne pollutants. Typically, a capped landfill is crowned with a hydroseed mixture of non-native grasses. These grass monostands have all the species-diversity of a suburban lawn. They are incapable of supporting a diversity of wildlife.

In 1989, the New York City Department of Sanita-

tation retained me to head a project which would demonstrate the benefits of planting a more diverse vegetative cover, and restore entire plant communities as they once existed in the City's coastal areas. We launched our project on a capped, six-acre nook of Fresh Kills, the planet's largest landfill. (Sprawling across 2,400 acres in Staten Island, it's three times the size of Central Park.) Potentially, the Fresh Kills landfill could be a key link to establishing the largest contiguous wildlife area in New York City.

The project's first step was to design undulating, dune-like slopes of compacted till soil to simulate coastal sites. Working in Fresh Kills' remote northeast corner — an area that borders a federally protected salt marsh — we instructed bulldozer operators to contour the landfill in a natural way. It wasn't easy at first, because the operators are trained to create uniform slopes, interrupted every 50 feet by flat benches with exact pitches. After a few false starts, they succeeded in duplicating the curves and bumps of a natural landscape.

To re-create the oak scrubforest, pine-oak forest, and ericaceous (acid-loving) shrubland that predate the landfill, we selected 18 native species representing the three distinct communities. Many of these species were hard to come by. With shovels and tree spades, we collaborated with the NYC Parks Department to "rescue" some plants from sites slated for development. Unfortunately, five entire species could not be found, even with the services of a plant broker.

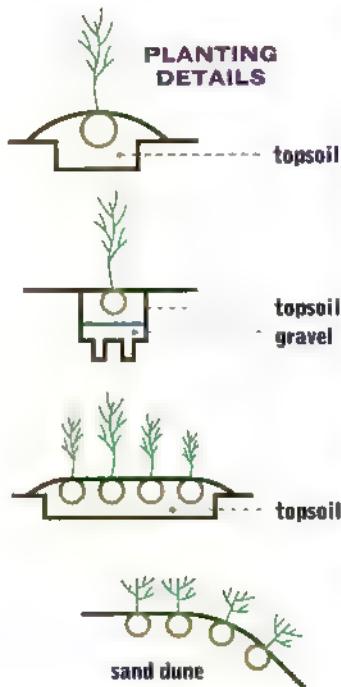
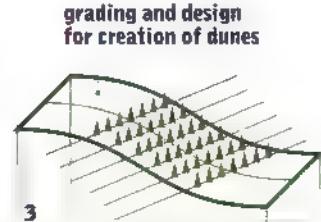
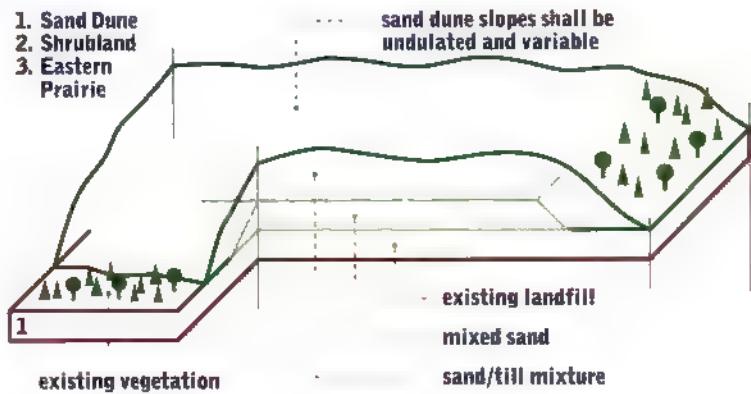
With autumn's west wind at our backs, we started planting. Approximately 3,000 shrubs were planted in small clusters among the three sites, and 500 trees were distributed among the pine and oak dunes. In addition to woody species



Five years after planting, the landfill is carpeted with an oak scrubforest (left), a pine-oak forest (right), and a grass shrubland (foreground).

## DEMONSTRATION PLANTINGS

1. Sand Dune
2. Shrubland
3. Eastern Prairie



such as oak, pitch pine, and beach plum, the site was over-seeded with native perennial grasses and wildflowers including Indian nutgrass, native aster, and black-eyed Susans. Instead of planting trees and shrubs in orderly rows, we tried to mimic the seemingly random arrangements of the surrounding natural areas.

The plants received just minimal care during the critical first year: pruning and staking, an application of anti-desiccant on the pines, and the requisite heavy mulching. Conditions on the landfill's slopes are quite harsh. Irrigation systems are impractical on remote sites like Fresh Kills, so waterings are sparse. A constant wind blows off of the nearby Arthur Kill (river), which desiccates the plantings. Landfill restoration is not gardening. You expect some losses.

In 1991, the Sanitation Department hired Rutgers University to assess our efforts. In previous surveys, Rutgers' ecologists noticed that old landfills often fail to succeed beyond early weed species, even after 20 years. However, the study showed that the trees we planted provided much-needed perching sites for northern harriers and red-tailed hawks, and habitat for herbivores such as rabbits, voles, and mice. Their droppings, loaded with seeds, greatly accelerated the successional process. After just one year, natural recruitment had boosted the number of woody species from 18 to 50 (adding 14 tree, 10 shrub, and 8 vine

species), enriching the plant community with more than 1,000 new woody "volunteers" (i.e., trees we didn't plant). We've jumpstarted this disturbed area's first pulse — it's already undergoing succession into a coastal scrubforest.

What we've reproduced is very much a "synthetic ecology." Yet the demonstration project has shown us that a secured landfill can act as a repository for threatened and endangered plants, and a habitat for birds and small mammals. Staten Island has seen losses of more than 40% of its plant species over the past 80 years as the area has undergone development. While no substitute for protecting natural areas, landfill restoration preserves the local gene pool and adds to the ecosystem's biodiversity.

Ultimately, we hope to see a restoration and stewardship ethic adopted in landfill-closure regulations. More than 1,000 acres of the Fresh Kills landfill is currently slated for final closure. Returning that land to created habitats and linking them with nearby natural areas taps the tremendous potential for secured landfills to become ecological oases.

WILLIAM YOUNG, a registered landscape architect, was the director of the restoration demonstration project at Fresh Kills. Readers can reach him at Roy-Fisher Assoc. Inc. in Jupiter, Fla. 33458; (407) 747-3462.



**I leave my computer on most of the day. Does it use a lot of energy? Should I turn it off, even if I'm just going out for a little while?**

DONOVAN JOHANSEN, GREEN BAY, WIS

PERSONAL COMPUTERS ARE THE COMMERCIAL WORLD'S FASTEST growing users of electrical power, currently accounting for up to 5% of the nation's commercial energy use. The share of the energy pie consumed by computers could double by the year 2000. Part of the reason is simple: One out of three PCs is left on 24 hours a day. Most are doing nothing but using up electricity.

So, you should turn off your computer when you go to lunch, right? Not necessarily, according to a recent report in *Energy Policy*. On economic grounds, factoring in worker salaries as well as costs of damaged hardware reveals that shutting off personal computers for one or two hours is not a cost-effective use of workers' time. However, shutting off the monitor and leaving on the central processing unit (CPU) takes little time and saves a substantial fraction of the PC's energy use. Shutting off both the CPU and monitor overnight and during weekends saves energy and extends the PC's useful lifetime.

Personal computers are themselves becoming more energy efficient. Some of the energy-saving designs developed for portable laptops have been transferred to desktops. An energy-efficient computer is cheaper to run, which is a significant marketing edge in a competitive sector.

The federal government has introduced the Energy Star Computers program, a voluntary effort whereby computer makers receive priority in federal purchasing if they meet EPA criteria — a move that could further boost energy efficiency, since the government is the world's largest buyer of PCs.



**How much fossil-fuel energy does it take to produce a gallon of ethanol derived from corn? From an environmental standpoint, is ethanol a worthwhile additive to gasoline?**

JOHN W. BETTENHAUSEN, SPARTA, N.J.

ETHANOL (ETHYL ALCOHOL) IS MADE FROM FERMENTED CORN BY-products and added to gasoline to increase its oxygen content. Debate surrounding the pros and cons of ethanol constitutes one of those "environmental issues" where the truth is easily lost in the torrent of tit-for-tat studies financed by the competing industries involved, in this case petroleum companies (anti) and the corn growers (pro).

The arguments get complicated because, while ethanol may result in some reduction in air pollution from cars during winter months and is produced from a renewable resource, it may actually contribute to smog during the summer. Its benefits should also be weighed against the environmental consequences of growing corn and the poor economics of corn as a source for ethanol. Major increases in nationally mandated ethanol would be a boon to domestic corn growers, but would also likely cost consumers and taxpayers more — without accompanying environmental benefits.

Life-cycle analyses of ethanol tell us as much about the limits of LCAs as they do about whether manufacturing and using ethanol is a net benefit to the environment. That said, the question of whether more fossil-fuel energy is used in the production of ethanol than ends up in the energy content of the ethanol itself can be answered



with a qualified "yes," according to the available LCAs. A study conducted by the Institute for Local Self Reliance (and distributed by the National Corn Growers Association as part of their pro-ethanol campaign) concludes the following:

"Assuming an average efficiency corn farm and an average efficiency ethanol plant, the total energy used in growing the corn and processing it into ethanol and other products is 75,811 BTUs per gallon. Ethanol contains 76,000 BTUs per gallon and the replacement energy value for the other co-products is 24,950 BTUs. Thus, the total energy output [for producing ethanol and corn co-products] is 100,950 BTUs and the net energy gain is 25,139 BTUs, for an energy output-input ratio of 1.33:1."

Translation: According to the pro-ethanol side, ethanol does not present a net energy gain until you count the energy content in the other products produced from the same corn used to make a given batch of ethanol. These are mostly food products, like corn oil, protein feed, gluten meal, refined starches, and carbon dioxide (the source of fizz for carbonating soft drinks), for which the Institute then assigns energy values.

Seems a little iffy to me. At the least, it demonstrates the zigs and zags of life-cycle analysis. The National Renewable Energy Laboratory undertook a similar analysis and came up with this clear-eyed conclusion: The fossil-fuel savings obtained by the use of ethanol from corn in reformulated gasoline are largely canceled by the greater use of fossil fuels in the actual growing and processing of the corn to make ethanol.

## Is it true that carbon-monoxide poisoning is a problem for homeowners? How do I know if my family is at risk, and what should I do about it?

JILL KLEGGER, KNOXVILLE, TENN.

CARBON MONOXIDE (CO) IS AN ODORLESS, COLORLESS GAS. WHEN INHALED it replaces the oxygen in the bloodstream, causing headaches and nausea in small doses; it can cause dizziness, coma, and even death in larger doses. Children and fetuses are at highest risk because they have higher metabolic rates than adults and absorb the pollutant faster. A report published in the *Journal of the American Medical Association* estimates 10,000 people in this country annually seek medical attention because of unintentional CO poisoning.

Apart from times when people burn charcoal briquettes in indoor fireplaces (a definite don't), CO poisoning is most likely to occur in homes with natural-gas furnaces. If the burners are improperly adjusted or the furnace vents are blocked, natural gas may not burn completely. Check your furnace flame. A predominantly yellow, flat, "lazy"-looking flame in a natural-gas furnace indicates fuel is not burning efficiently and is releasing higher than usual levels of CO. Check all the connections to flue pipes and venting systems for cracks, gaps, corrosion, or debris. A rusted or pitted flue pipe from your furnace and water heater to the chimney could also be a problem. Burner and blower compartment doors must be in place on your furnace at all times. Also check to make sure your chimney is not clogged.

The Consumer Product Safety Commission recommends installing at least one carbon-monoxide detector in every household. These operate much like smoke detectors, and will sound an alarm when CO levels go above 100 parts per million for 90 minutes — a level too low to cause even a headache in most people. Some alarms can sound at less than half that level if exposed for several weeks. They run between \$40 and \$80 and can be found at most hardware stores.





## Breakthrough Books

**S**INCE GARBAGE WAS FOUNDED, I'VE been instructed and provoked by dozens of excellent books. The two here, although not at all similar, stand out. Both laid groundwork so that I could read more deeply into (or between the lines of) everything I read subsequently.

One provides a foundation in toxicology, allowing the intelligent reader to break through the selective factoids used to scare us regarding the impact of various chemicals on human health. The other, a scholarly but humanistic discussion of the devastating implications of radical environmentalism, breaks through increasingly popular assumptions to explain how the ideology of the deep greens seeks to dismantle modern civilization.

"If at times my aspersions are caustic, it is because I have had to battle against these seductive ideas myself," writes Martin Lewis in his Introduction. A committed, "liberal moderate" environmentalist, the author contends that it is the deep ecologists and eco-extremists themselves who pose the greatest threat not only to the Movement, but to humanity and world ecology as well. Lewis distinguishes the main variants of eco-extremism, lucidly describing antihumanist anarchism, primitivism, humanist eco-anarchism, eco-marxism, and radical eco-feminism. With reasoned argument, fact, and explicit examples, he exposes the fallacies that underlie their arguments.

... radical environmentalism rests on four essential postulates: that "primal" (or "primitive") peoples exemplify how we can live in harmony with nature (and with each other); that decentralization, leading to local autarky, is necessary for ecological and social health; that technological advance, if not scientific progress itself, is inherently harmful and dehumanizing; and that the capitalist market system is inescapably destructive and wasteful.

... I will argue that each of the four essential postulates is directly contradicted by the empirical record. "Primal" economies have rarely been as harmonized with nature as they are depicted; many have actually been highly destructive. Similarly, decentralized, small-scale political structures can be just as violent and ecologically wasteful as large-scale, centralized ones. Small is sometimes ugly, and big is occasionally beautiful. Technological advance, for its part, is clearly necessary if we are to develop less harmful ways of life . . . . And finally, capitalism, despite its social flaws, presents the only economic system resilient and efficient enough to see the development of a more benign human presence on the earth.

... Radical environmentalism's ecology is outdated and distorted, its anthropology stems from naive enthusiasms of the late 1960s and early 1970s, and its geography reflects ideas that were discredited sixty years ago. Moreover, most eco-radicals show an unfortunate ignorance of history and a willful dismissal of economics.

— from the Introduction, *Green Delusions*

Deeper into the text, the reference-laden writing is reassuring but sometimes difficult. I found, however, that this book was the first to address my unease with ideological threads that work their way even into mainstream environmentalist thinking and rhetoric. I read it cover to cover. It had a profound effect on me — like cleaning my brain.



*Green Delusions*, by Martin W. Lewis. 1992. 288 pages. Duke University Press, PO Box 90660, Durham, NC 27708. Hardbound, \$27.95 ppd.



*The Dose Makes the Poison*, by M. Alice Ottoboni, PhD. 1991. 244 pages. Van Nostrand Reinhold, Order Dept. (609) 525-6600. Hardbound, \$24.95 + state sales tax.

ALICE OTTOBONI WAS STAFF TOXICOLOGIST WITH the California State Department of Public Health for over 20 years. She wrote the first edition of *The Dose Makes the Poison* in 1984 to address what she called "poison paranoia" among the general public. The second edition, published in 1991, is somewhat reorganized and expanded.

Dr. Ottoboni has been sufficiently disgusted with ignorant reporting to have coined such terms as "news media toxicology." To a great extent, however, she confines her viewpoints to a concluding chapter called "Public Distrust of Science." Most of the book is an unbiased, nearly textbook explanation of the science of toxicology in lay terms: How do chemicals cause harm to the

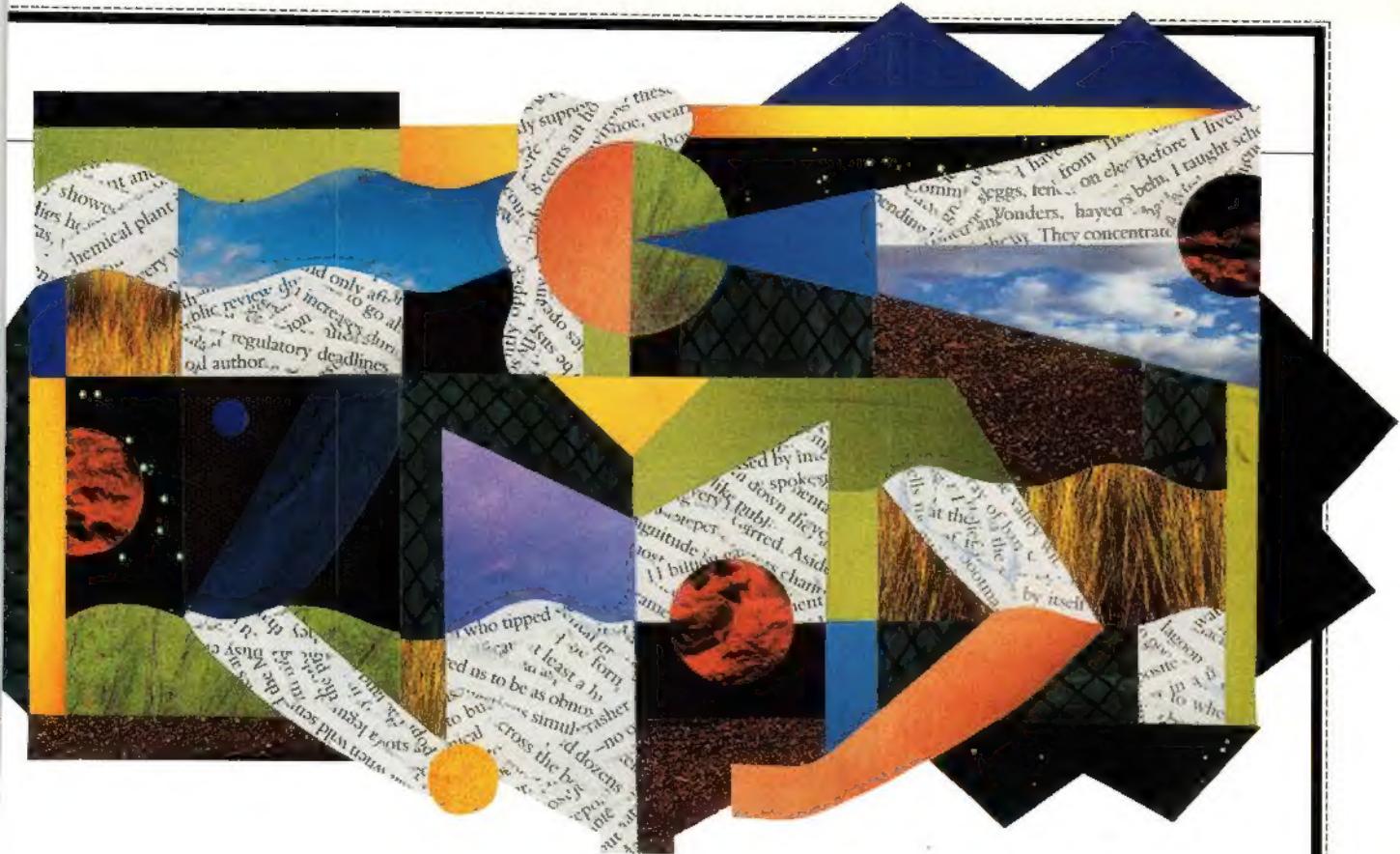


ILLUSTRATION BY David McLimans

body? What is the dose-time relationship? the difference between acute and chronic toxicity? How does route of exposure influence toxicity? Even these simple concepts are consistently misrepresented in popular accounts of the toxicity of synthetic chemicals. (In my own experience with writers, the misrepresentation was almost always the result of ignorance, not deception . . . another reason I'm recommending the book.)

The author starts at the beginning with the language of toxicology — words that have lost clarity or taken on unfounded meanings due to popular misuse. She defines "chemical," "poison" and "hazard," "natural" and "synthetic." A precise vocabulary becomes critical as she builds the reader's knowledge. Chapters untangle mutagenesis and carcinogenesis, as well as reproductive toxicity. As far as I know, Ottoboni is the only science author to explain the phenomenon of "sufficient challenge" to a lay audience. Methods of study are explained, and a chapter is devoted to human experience: accidents and contamination that provided unwilling human subjects for toxicological study. The largely new chapters on epidemiology and risk are excellent, again providing the basic vocabulary and precepts.

Why is this book important? Dr. Ottoboni explains in her Preface:

The majority of laws [regulating environmental chemicals] were written by legislators . . . Laws enacted by legislatures are subjected to extensive review and refinement prior to passage. During the review process, legislators receive the benefit of scientific input and public comment.

A few of the laws regulating chemicals that have been passed in recent years were . . . enacted through the initiative process. Initiatives are written by a sponsoring group and submitted to the public in petition form. They are placed on the ballot if their petitions receive the required number of signatures. Initiatives are subject only to political debate. If they become law, they are fairly well protected from legislative modification.

Organizations who consider that governmental officials are indifferent to environmental pollution have bypassed the legislative process and have gone directly to the people. These campaigns have benefited by exploiting the public's fear of chemicals.

The initiative process makes the need for an informed public more critical than ever. Sound decisions require an understanding and knowledge of all sides of issue. This book was written in the belief that knowledge of what makes chemicals harmful can help dispel unreasoning fear. . . .

Were the precepts of Dr. Ottoboni's book common knowledge, I wonder, would the proposal to consider all chlorine-containing compounds a single family of potential toxicants even be considered? More provocatively, given Lewis's arguments, is the proposed ban an attack not on chlorine, but on technology? 



## PETA's Pig Fight

**I**T IS WIDELY ASSUMED THAT ANIMAL rights' organizations are natural allies of the environmental movement. So why has People for the Ethical Treatment of Animals declared war on a leading conservation organization? PETA has launched a frontal attack on the Nature Conservancy, including a national boycott against its corporate sponsors.

This is bound to put an even greater chill on companies who wish to support environmental causes.

The Nature Conservancy incurred PETA's loathing by snaring feral pigs in its Hawaiian preserves. Scientists say the alien swine, which were introduced by Europeans in the late 18th century, are the single greatest threat to Hawaii's native biota. The islands' biodiversity evolved over millions of years without ground mammals, so endemic species are defenseless against exotic pigs and the diseases they help spread. At least half of Hawaii's native bird species have been driven to extinction, largely because of the havoc wreaked by domesticated animals turned loose in the islands' rainforests.

The Nature Conservancy is taking a bold yet well-reasoned action to protect native flora and fauna by fencing and live-trapping feral pigs. As a last resort, hunters are using wire snares in fragile, rug-

ged terrain where no other method has succeeded. PETA's response: Let the pigs be.

The Hawaiian pigs story is hardly an open-and-shut case of animal abuse. In fact, the Nature Conservancy has sought the counsel of humane organizations, including PETA, and continues to search for alternatives to selective snaring. The facts don't figure into PETA's hate campaign. PETA-inspired protestors have attempted to enter the Conservancy's headquarters. Others, in a bid to intimidate, have openly photographed employees of the Nature Company — a Conservancy supporter — as they leave work. Outraged animal rightsters have even sent a score of death threats to Conservancy staffers.

One could dismiss the threats as empty-headed ravings from the fringe. Even so, environmentalists are considering severing ties with the animal-rights movement, as PETA's protests become increasingly strident. Luminaries from the Sierra Club, the Rainforest Action Network, the National Audubon Society, the Earth Island Insti-

ture, and Defenders of Wildlife have written to PETA asking it to call off the attack. PETA has refused. Apparently, People for the Ethical Treatment of Animals' brand of ethics considers the extinction of entire communities of species the moral tradeoff for protecting a few destructive invaders. Moreover, their ethics allow the use of intimidation tactics to get their point across.

In a letter to PETA's leaders, Chris Willie of the Rainforest Alliance writes:

"I cannot accept attacks on an organization that saves the [habitat] and lives of countless animals throughout the Americas ... You have defined your organization as cultist, doctrinaire, and singleminded. I am sorry to see that." Amen.



## MISSION STATEMENT

GARBAGE is independently published and has no ties to any political movement, industry, membership group, or activist organization. Furthermore, the editors endeavor to present topics of environmental concern from a journalistic perspective, rather than an advocacy perspective.

The mission of the magazine is...  
...to follow in the tradition of a journal—looking to expert sources, providing depth of coverage, introducing the affiliations of all writers, offering analysis and perspective, and soliciting counter-points.

...to predict and then research the important stories and controversies.  
...to allow for skepticism (on all points of view), but with insight and a dose of humor.

...to allow science to speak, and allow policy to speak—and endeavor to explain which is which.

Finally, GARBAGE provides a forum where sometimes discordant groups—scientists, industry leaders, environmentalists, journalists, and public servants—may speak on the record before a diverse readership. Through presentation of a range of topics and opinions, the editors try to speak to the intrinsically human needs that gave rise to the modern environmental movement, while not ignoring science, while not discounting history, and while paying heed to risk assessment, prioritization, and economics.

**Biophilia Hypothesis**, noun — The theory that humans have a genetically based emotional affiliation with other fauna (and flora). Coined by Harvard biologist Edward O. Wilson in his 1984 book *Biophilia*, adherents of the hypothesis believe that developing a close connection to Nature may be as important to *Homo sapiens*' psychological well-being as forming close personal relationships with other members of our own species.

The hypothesis holds that, like many other hereditary traits, the degree to which biophilia is expressed in people depends on the social environment to which they are exposed and their learned responses to those stimuli. Hence, city-bred youths who are removed from Nature can grow up indifferent or even hostile to it. Cut off from a source of psychic vitality, they join the ranks of people who allow degradation of the natural world to occur.

A new book entitled *The Biophilia Hypothesis* (Island Press) presents 18 authors from various disciplines who lay out the arguments and the evidence for proving biophilia. Dr. Roger S. Ulrich, an environmental psychologist at Texas A&M University, points to research showing that people seem to favor photographs of natural scenes over urban ones. He also cites widespread phobias of spiders and snakes as evidence that humans bear genetically encoded feelings about Nature.

Arguments against the hypothesis are not hard to make. In his 1984 book, Dr. Wilson suggests hopefully that if people come to believe in biophilia, they will be more committed to environmentalism. Which begs the question: If biophilia is genetically inherited, why should people have to be mobilized to protect the environment? As U.C. Berkeley sociologist Claude S. Fischer points out in a review of the book in *Science*, just because a habit and thought is shared by a great many people does not mean it is genetically based. "Should we posit a TV gene?" Dr. Fischer asks facetiously.

Clearly, most of us derive aesthetic and even spiritual sustenance from the natural world. But until stronger evidence emerges, the biophilia hypothesis will remain just that — a theory put forth by people who believe our reverence for Nature springs from our DNA.

